MICROFILMING

E. Leitz, Inc.

Microfilm may be read with a magnifying glass although almost microscopic in its details

MICROFILMING

BY

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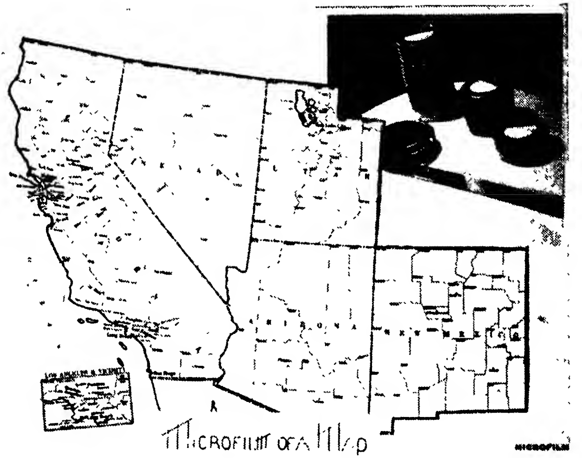


Microstat Corporation

Microfilm of a 24 by 36 inch map slightly enlarged. Full size enlargement shows all city and county names.

Chapter I

WHAT IS MICROFILMING?

Microfilming is specialized photography. Photography, simply defined, is producing pictures by means of the action of light on light-sensitive substances. Most readers know the "means" to be a camera or printing frame, a sensitized substance such as film or paper, and an array of fairly complex chemical compounds. Photography, as we know it today, had its birth a little more than a century ago. Most pioneer photographers began their careers as painters, and for this reason the process has been called "painting with light."

Microfilming, also called microphotography, consists in the reduction of images to such small size that they cannot be read without optical assistance. This amazing photographic compression often results in a ninety-nine percent saving of space.

Microfilming, therefore, is compressed recording used to preserve vital records or documents on strips of high contrast, high resolution, safety film. Anything ever drawn, written, or printed can be microfilmed. Explaining the "why" and the

"how" of this unique photographic process is the purpose of this handbook.

Microfilming preserves from destruction and deterioration, the words and creations attesting to man's efforts. Ancient coins and manuscripts, military communications and V-mail, checks and contracts, statistics and correspondence, drawings and maps, even X-rays, can all be preserved.

Advanced leaders in American government have long been aware of the need for microfilming.

In 1791 Thomas Jefferson wrote:

"Time and Accident are committing daily havoc on the originals (of valuable historical and state papers) deposited in our public offices.

"The late war has undone the work of centuries in this business. The lost cannot be recovered; but let us save what remains; not by vaults and locks which fence them from the public eye and use in consigning them to the waste of time, but by such multiplication of copies as shall place them beyond the reach of accident."

Recently Franklin D. Roosevelt declared:

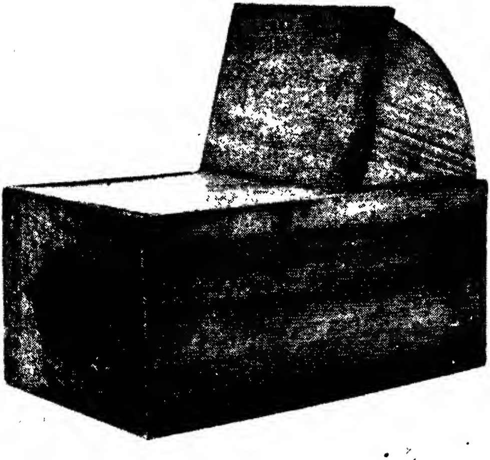
". . . because of the conditions of modern war against which none of us can guess the future, it is my hope that it is possible to build up an Amer-

ican public opinion in favor of what might be called the only form of insurance that will stand the test of time.

"I am referring to duplication of records by modern processes like microfilm so that if in any part of the country original archives are destroyed a record of them will exist in some other place."

Persons alive to current technological developments need no extensive introduction to microfilming as accomplished by means of high-precision microphotographic technique. But a knowledge of this technique, together with its possibilities in terms of effective personnel placement, may give direction and meaning to those inquisitive readers who are bored with the monotonous aspects of their occupations. Curiously enough, the very same occupations, interpreted in terms of microfilming, take on new design.

While the majority of microfilming operations are now conducted by men, women are not barred from the profession. At least one progressive and nationwide firm has made strenuous and successful efforts to employ women. The same degree of mechanical aptitude is required of women as of men. The same general requirements also hold. Personal integrity, to be sure, is paramount; for the work is often highly confidential.



The Museum of Modern Art

Camera obscura constructed before 1800. The circular opening was fitted with a simple lens. Images were reflected to a groundglass on top of the apparatus.

Chapter II

HIGHLIGHTS OF MICROPHOTOGRAPHIC HISTORY

The basic advances in the history of microphotography have not come as the result of mere chance or fortuitous guesswork. Painstaking, and costly research are represented in every apparently obvious operation in the high-precision microphotographic process of microfilming. By way of example, we can state that one of America's leading microfilming service organizations was in a position to take in its first thousand dollars only after an investment of approximately three-quarters of a million dollars in camera research and design, experiment, lens tests, and emulsion formulation. And research continues in its laboratories and in those of many other established firms. Better quality and quantity demands, from an increasingly discriminating market, make such research imperative.

Microfilming's origins cannot be severed from those of photographic and optical principles reported by the great Greek natural historian, Aristotle, who observed in the fourth century before

Christ that sunlight, if permitted to enter a small hole in the wall of a dark room, casts on the opposite wall an inverted image of whatever is outside the hole. Since Aristotle was not only a reporter of contemporary physical phenomena, but a recorder of facts well known to ancient and classical civilization, it may be surmised that this principle was known before his day.

In medieval times Leonardo da Vinci describes just such a dark room in his celebrated notebooks and calls it the *camera obscura*. About 1560 draftsmen fitted the hole of such rooms with a lens in order to make the image brighter. By tracing the outlines cast on the opposite wall of their *camera obscura* they learned the principles of perspective or three-dimensional drawing. Magicians delighted their audiences by seating them inside such darkened rooms while they conducted theatrical performances outside. These primitive moving picture shows stimulated the construction of portable dark rooms and by the early part of the eighteenth century we learn that the *camera obscura* was a part of every artist's equipment. The artist's apparatus, not much bigger than an 8 x 10 inch camera, was fitted with a lens which he pointed at the scene he wished to sketch, while inside the *camera obscura* a mirror reflected the

image onto a ground glass. Placing a thin piece of paper over the glass the artist proceeded with his delineation of the scene before him and his "camera." Many modern microfilm reading machines are constructed on just this principle. Omitting the ground glass we discover that if the light source is of sufficient power, the image will fall directly on the paper from the mirror or a reflecting prism. This type of instrument is the *camera lucida,* still used by microscopists and by more artists than dare admit the need for this mechanical aid.

Skipping Johann Heinrich Schulze's experiments from which the German physician concluded that salts of silver reacted to sunlight, and Thomas Wedgwood's attempts to fix profiles on the surface of his father's celebrated ceramic pots, we at last meet the father of photography, Joseph-Nicéphore Niépce, a French army officer, inventor, and lithographer. Between 1816 and 1829 he actually succeeded in capturing a few photographic images. Instead of being elated, however, he described his results in terms of failure. His images were "negative" as we understand the term photographically. Skies were black, trees white; nature was reversed. But for the help of an engraver his work would remain unknown.

In 1826 Niépce copied a picture of a French church dignitary with his own camera, had an engraver deepen the image produced on his bitumen-covered pewter plate, and from the plate pulled a positive portrait. This photoengraving success brought his work to the attention of another French inventor, Louis-Jacques-Mandé Daguerre, who was celebrated both for his work as an artist and for his startling dioramas. Working together they found that coating polished silver or copper plates with light-sensitive chemicals, developing the latent image with iodine or mercury vapor, and fixing the plate in salt water, resulted in "positive" images.

Niépce died before the process was fully perfected, and his partner, Daguerre, usually gets full credit for the "discovery of photography" which he announced to the French Chamber of Deputies in January, 1839. In return for a pension from the government he released the process to the general public in August of that year.

A veritable daguerreomania set in and wealthy amateurs aimed their cameras at objects that would hold still for the minimum exposure required—twenty minutes. Architectural subjects were popular. Later head and body clamping portrait chairs were devised and the daguerreoma-

The Museum of Modern Art

Photoengraving of Cardinal D'Amboise made in 1826 by Niépce.

niacs began taking pictures of themselves, their families, their friends—and finally, as their purses ran empty—their clients.

Across the Channel on January 31, 1839, an English scientist, William Henry Fox-Talbot released his invention of "photogenic" methods to the Royal Society. He had worked independently of Niépce and Daguerre since 1833 and was greatly surprised to learn of the latter's "discovery" made known to the French only a few days before his publication addressed to the Royal Society appeared in London. At the same time another Englishman, the mathematician Sir John F. W. Herschel, proposed the compression of scientific records on microscopic film negatives which could be used for preserving public records. He discovered the preserving action of hyposulfite of soda. Sir John promptly introduced "hypo" as a fixative for daguerreotypes and talbotypes, as well as the terms *photographic*, *negative*, and *positive*.

The next year, 1843, found Fox-Talbot publishing his photographic treatise *On Photogenic Drawing*. This was quickly followed in 1844 by the first photographically illustrated book, *The Pencil of Nature*. Fox-Talbot also went a step ahead of Daguerre in discovering the properties

of the negative and making positive copies from it. His emulsions, poured on flat polished glass plates, consisted of chlorides and iodides of silver, and later, silver bromide. Daguerre's process yielded but a single picture; Fox-Talbot's was capable of repeated duplication. However, the daguerreotype commanded high prices because of its very exclusiveness, while the more practical talbotype—later called callotype—was virtually forgotten.

Fox-Talbot's writings remain classic and his camera requirements read "the eye of the instrument should not have too large a pupil, that is to say the glass (lens) should be diminished by placing a screen or diaphragm before it" as "the resulting image is much more sharp or correct." Furthermore, Fox-Talbot might well be called not only the co-father or founder of photography but also the pioneer in the field of documentary reproduction. In the course of his numerous experiments he copied drawings, engravings and manuscripts on his glass plates much as today the copying is done on microfilm. Lens grinding and designing also aided greatly, and in 1840 we learn that the Hungarian optician, Josef Petzval, working for the Viennese firm of Voigtländer, then as now makers of lenses, produced an f/3.4 portrait

lens which made exposures of one minute feasible. Copying lenses were slower, however.

The first microphotographs were produced as early as 1840. By the 'sixties they were being produced in quantity by Frederick Scott-Archer's collodion process. This process, now obsolete, was discovered by him in 1851, and went far to advance microphotography.

In the pages of *Discovery* for 1938 R. E. D. Clark writes of the application of microphotography to espionage:

> "In the *Photographic News* for 1859 and 1860 various suggestions for the use of such photographs were put forward. It was suggested that they would be very useful to spies in war time, who might thus carry large numbers of documents about their person in such minute form that there would be little fear of discovery even after careful searching. There was, for instance, scarcely a limit to the quantity of material which could be carried in a single button or in the ornamental top of a pencil."

It was further suggested that military documents could be microphotographed, the strip film placed inside a hollow bullet, and the message

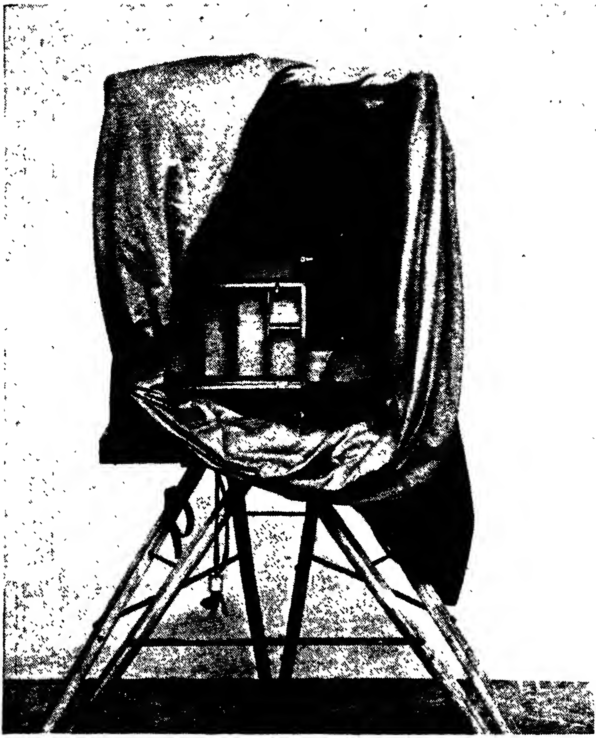
shot over enemy occupied territory. Some wit even proposed that the entire archives of a nation could be photographed and compressed to fit into a snuff box. Others took advantage of the discovery and began introducing microphotographs into rings, scarf pins, and brooches. These novelty jewelry items were fitted with a tiny lens and viewed against the light. Pocket knives made in the middle 'sixties sold in England for three shillings. The microphotos were mounted in the axis of the knife blade and covered with a lens. Many of the pictures, often as small as the head of a pin, displayed such subjects as "The Soldier's Dream," "Prince Albert," and a number of views that caused at least one photographic magazine to deplore the use of such wares for the portrayal of pornography. Some of these curiosities are still extant and as recently as 1938 were on exhibition at the Science Museum in South Kensington, London.

The success of the operation lay in sharp focusing and in the white of egg albumen emulsion which when coated with silver was developed in as short a time as twenty-five seconds. This gave little chance for the exposed silver grains to float about or to swell in size. Pieces of glass were used to hold the albumen emulsion and were first cov-

ered with collodion to which a mixture of bromides, iodides, and candy sugar in solution was added before coating with white of egg and dipping in a silver bath. The results of this process were remarkable and one side of the London *Times* was reduced to the size of a finger nail. Every letter on the printed page was legible when viewed under a microscope and it is important to recall that newspapers of the last century used smaller type.

In 1864 we find the French photographer, Prudent René Patrice Dagron, of whom more later, complaining that although microphotography already represented quite an industry in Paris, most writers on photography did not consider this branch worthy of attention. By this time the methods were fairly well known and the process was widely used in the manufacture of novelty souvenirs and the duplication of "French postcards" of the day.

The Franco-Prussian War, as we remember from history, saw the Prussian troops overrunning France and in 1870 surrounding Paris and cutting that capital off from the outside world. With characteristic thoroughness the Germans dug down to every buried telegraph wire to either destroy the line of communication or interrupt



The Museum of Modern Art

Dark tent for sensitizing plates—1865.

its progress beyond their lines. They even dredged the mud of the Seine for wires. By September the Parisians were isolated and tried to send out messages by means of oiled silk balloons. For news in the opposite direction they relied on carrier pigeons which were sent out by larger balloons to unoccupied territory and there released with messages. However, because of the weight of the paper on which the messages were written, many of the birds fell into enemy hands and only a few reached Paris.

Microphotographer Dagron saw his chance at this point and quickly convinced the beleaguered Paris government to let him try his process and his luck. In November he left Paris in a balloon christened the "Niépce" and accompanied by another named "Daguerre" which the Prussians captured. Dagron was successful in getting out of his balloon with just enough time to spare. He dressed himself in peasant clothes, packed his microphotographic camera, plates, and chemicals into empty wine barrels, and borrowed a farmer's cart. He was stopped by Prussian sentries but so well had he disguised himself that he succeeded in getting their officers to give him a permit to cross their lines and go to Tours with his "wines."

Once in Tours we learn that Dagron organized

the copying of dispatches on thin transparent paper. These he photographed, stripped the emulsion from his glass slides, wrapped the strips in quill tubes, and attached the tubes to the wings of carrier pigeons. Released from Tours the pigeons reached Paris in record time as they were not burdened by heavy papers and hardly felt the weight of the film strips they carried.

When the pigeons reached Paris, the strip films were removed from the quills, flattened, placed between clear glass slides and projected in a darkened room onto a wall or screen. Here copyists took down what they saw on the wall before them and forwarded the messages to the parties addressed. Later improvements were made by substituting sheets of sensitized paper for the screen and printing the messages by direct projection enlargement. Thus V-mail had its historic precedent in a previous conflict also involving Gauls and Prussians.

Most remarkable was the fact that the primitive apparatus and means at the disposal of Dagron were capable of copying sixteen pages of a Paris newspaper, set in smaller type than modern papers, and compressing all on a strip of film not much larger than a modern non-perforate frame of microfilm. The message service, how-

ever, was much more costly than V-mail, as the fee for sending a dozen words was a franc. Despite the cost, more than 115,000 official dispatches and more than 1,000,000 private letters and money orders, *mandats*, were flown by pigeon post on strip microfilm.

The next development of significance introduces an American chemist and amateur photographer who in 1884 was granted a patent for "stripping film." This meant that a gelatine emulsion was secured to a paper base and after exposure was stripped. Before this time such stripping, as in the case of the Paris pigeon post, was done from glass plates. A dozen 5 x 8 plates, for example, weighed fifty ounces. A dozen stripping films weighed less than four ounces. The inventor was George Eastman of Kodak fame. "Kodak" was the trade name originated by Eastman, because, he insisted, it resembled "the click of a shutter." He also chose this name because it was pronounceable in several languages.

Eastman's efforts met with great success and one of his first customers was an electrical genius, Thomas A. Edison, who built a moving picture camera. George Eastman then set about to supply the necessary film. His sensitive gelatine emulsion was supported by a flexible but somewhat dan-

gerously inflammable plastic known as celluloid or nitrocellulose, which appeared on the American scene in 1889.

Microfilm, as we know it today, had only to await the substitution of safety-base, slow-burning film made of cellulose acetate. While this was not immediately available the future of microphotography was fully assured with Eastman's genius for harnessing invention to organization to merchandising to mass distribution. Eastman's four-in-hand team rapidly galloped ahead. Many equally ingenious innovators were lost in the dust set up by the Kodak cavalcade. Only a few survive to remember the early beginnings but all look ahead to the rapid changes and accelerated tempo of microphotographic advance.

World War I witnessed the emergence in 1913 of the miniature Leica camera designed by Oscar Barnack, a German microscope designer, and manufactured by E. Leitz in Germany. It achieved full stature in 1924 as a scientific instrument capable of copying documents, books, maps, coins, etc., and was not merely another vest-pocket oddity. The Leitz product was rapidly duplicated and improved by the Zeiss Contax, invented by a German, Dr. Emanuel Goldberg. The French Pathé company developed a fifty-foot continuous

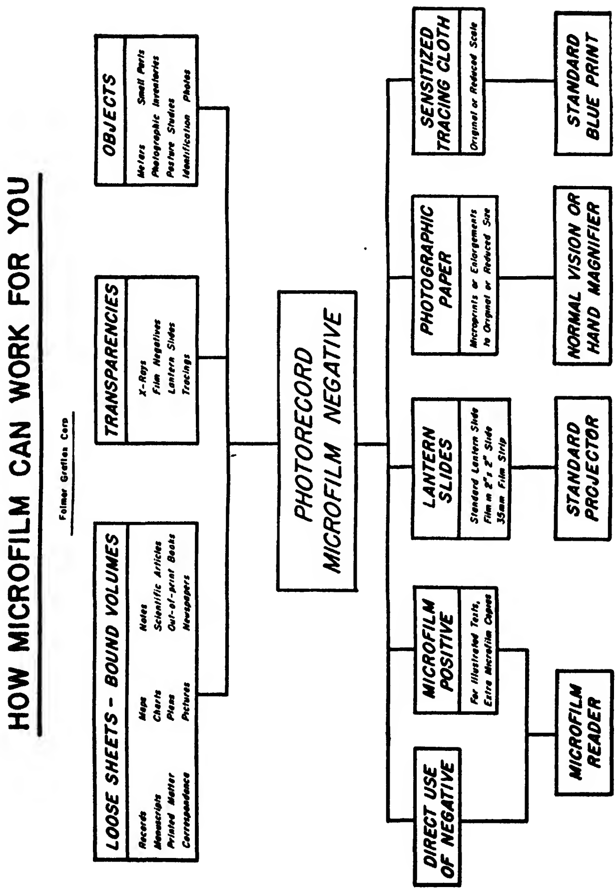
or single-exposure motion picture type of camera —the Sept. All three of these were 35 mm. cameras using motion picture film. All were utilized by today's generation of microphotographers in making their own equipment, creating new methods, licking the bugbear of "grain," learning the essentials of microfilming. Other advances were made with converted motion picture and animation cameras of the type used by Walt Disney's and Max Fleischer's technicians.

Rear Admiral Bradley A. Fiske, inventor of the aerial torpedo, also devised a simple reading machine for microfilm, named the Fiskeoscope. In 1919 it was awarded the first reading machine patent granted by the *United States Patent Office.* However, the best result he could get was an enlargement of ten diameters because at that time fine-grain film and developers were still unknown quantities. Then he printed a Manhattan telephone directory putting four pages on a sheet of paper one-quarter actual telephone book size, but the cost of his telephone books plus the cost of his reader exceeded that of a telephone book in its normal size. He was also able to produce a full novel, on a few feet of film, but with no financial saving. His efforts were largely responsible for the innovation and elaboration of an-

other somewhat complicated reading machine, the Optigraph, which was built with the idea of revolutionizing reading habits in America. Its promoters made sundry and fantastic claims for its success, but after spending considerable sums of money on research, they were forced to cease operations because of lack of public interest.

Ozaphane, trade name of a film duplicating process, involving ammonia gas processing of diazo-dyed film, likewise was developed—first on cellophane, later on acetate and was called Ozalid film.

As *Microfilming* goes to press there are more than twenty microfilming companies serving the United States. More than two hundred American universities and libraries in the United States are equipped with microfilming service. Many of our Federal agencies as well as the United States Army and Navy possess well-equipped microfilming laboratories and servicing facilities.


HOW MICROFILM CAN WORK FOR YOU
Folmer Graflex Corp
LOOSE SHEETS - BOUND VOLUMES
Records
Manuscripts
Printed Matter
Correspondence
Maps
Charts
Plans
Pictures
Notes
Scientific Articles
Out-of-print Books
Newspapers
TRANSPARENCIES
X-Rays
Film Negatives
Lantern Slides
Tracings
OBJECTS
Meters
Photographic Inventories
Posture Studies
Identification Photos
Small Parts
PHOTORECORD MICROFILM NEGATIVE
DIRECT USE OF NEGATIVE
MICROFILM POSITIVE
For Illustrated Texts, Extra Microfilm Copies
LANTERN SLIDES
Standard Lantern Slide
Film in 2"x2" Slide
35mm Film Strip
PHOTOGRAPHIC PAPER
Microprints or Enlargements to Original or Reduced Size
SENSITIZED TRACING CLOTH
Original or Reduced Scale
MICROFILM READER
STANDARD PROJECTOR
NORMAL VISION OR HAND MAGNIFIER
STANDARD BLUE PRINT

Chapter III

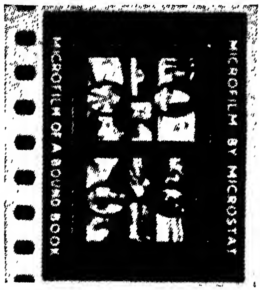
USES AND ADVANTAGES OF MICROFILMING

Despite the fact that a thousand square inches of copy can be reduced to one square inch of microfilm, not a line or letter of the original will be blurred or obscured on the film. Because of this unique photographic compression, filing space and equipment may be reduced more than ninety-nine percent, as has been said. One hundred business letters, each 8½ x 11 inches, when microfilmed, occupy less space than one ordinary letter. The contents of a four-drawer filing cabinet, compressed on a hundred foot roll of microfilm, occupy no more space than a doughnut. Fifty thousand large engineering drawings may be microfilmed and stored in a twenty-five dollar a year safe-deposit box, secure from fire, flood, theft, explosion, or sabotage. One four-drawer file of microfilm in an office indicates that the space formerly occupied by one hundred and twenty such files has been released for other purposes.

There are at least ten commercial advantages of microfilming as a method of duplication:

1. Speed—10 to 50 times quicker than photoprints.
2. Economy—up to 600%, cheaper in large quantities.
3. Photographic accuracy—no checking necessary.
4. Permanence.
5. Work done on the spot—where and when you want it.
6. No size limitations.
7. Low cost positive microfilm prints.
8. Originals insured through special policy.
9. Low cost storage readily available.
10. Court acceptance as evidence or legal proof that destroyed records actually existed.

Negative microfilm is the original microphotographic record made with a camera designed for the purpose. Often the camera is installed at the site of the records and the film sent to a specially equipped laboratory for processing and inspection. The negative microfilm in 35 mm. form is delivered in rolls containing about seven hundred and fifty exposures carefully packaged and la-



Negative Microfilm - by - Microstat, single perforate.

Positive Microfilm-by-Microstat, non-perforate.

belled. These negative rolls should be stored in a safe deposit vault.

Positive microfilm is a duplicate record made from the negative by contact printing. It is delivered in rolls and read by means of reading machines or microfilm projectors. Some users cut the rolls into short strips and file the film strips in indexed envelopes.

Paper enlargements are reproductions made from the negative microfilm by projection. They are intended principally for reading, although occasionally these enlargements are used like paper tracings for making blueprints and diazo reproductions (BW's, Ozalids, Directo's, etc.). A double-weight paper is available but owing to its opacity it is not recommended if blue or diazo printing is desired as the end product. Reverse reading prints, on single-weight paper, make better quality blueprints.

Cloth enlargements are more expensive, but more durable reproductions for making blueprints and diazo prints. They correspond to cloth tracings used in engineering industries.

Acetate enlargements make the best blueprints and diazo prints. They are projection enlargements made from microfilm negatives on acetate type photographic film. They are less durable

than cloth or paper reproductions and require greater care in handling. Acetates are chiefly useful in making sectionalized enlargements when drawings have been microfilmed in more than one exposure. Reduced scale prints, quarter area and letter size, are best made from acetates.

Diazo prints are made from single-weight paper, cloth or acetate film enlargements by contact printing and diazo development. Diazo prints are available in diazo paper, a final product used like a paper enlargement or a blueprint, and on diazo cloth or transparentized vellum paper, which in turn will serve as a duplicate tracing for making diazo paper prints and blueprints.

Pause and reflect as to what would happen to a firm if its records were destroyed. But isn't the firm insured? It probably is, but insurance doesn't bring back the vital plans, drawings, contracts, blueprints, etc. However, suppose the firm had the foresight to have their papers microfilmed and stored the negative rolls within their bank's safe deposit vault. Then it is a simple and relatively inexpensive operation, in the event of loss, to reproduce every single important document in clear black-on-white. Peacefully rests the executive who knows his records are secure, safely microfilmed, and far from destructive hands. Anyone

taking the trouble to investigate known duplicating processes, including hand copying, typewriting, photostating, blueprinting, etc., and comparing their cost, size limitations, and impermanence, with microfilming, will decide in favor of the more rapidly produced, lower costing, permanent and accurate records made with precision microfilm.

While the initial expense of purchasing microfilm equipment and providing it with adequate working space and personnel is costly, the profits reaped in this field are attractive. Vision, of course, is needed—vision of the sort that put commercially profitable radio on the ether, and aviation aloft.

Specific uses of microfilm can be described by citing the work of Elgin G. Fassel, assistant actuary of the Northwestern Mutual Life Insurance Company of Milwaukee, Wisconsin. Mr. Fassel in 1934 was confronted with the daily problem of effectively filing some nine thousand cards representing policies withdrawn from basic files. Other insurance companies had guarded against misfiling and loss by photostating, but this proved costly—in fact it would have cost his company nearly $50,000 a year. Mr. Fassel's investigations revealed that microphotography was the better way. "To control the file, why not retain the pic-

ture and let the original register card leave the file?"

Moving picture camera companies were consulted but declared his proposal impossible. Spurred on by this rebuff Fassel developed and built his own machines. He made it possible for his company to maintain a control on the day to day use of the register card file, to substitute microfilm records for permanent file documents which are destroyed to effect space saving. Finally the annual cost of record control was reduced to about $2000.00.

The Fassel camera microfilms cards at the rate of 130 per minute and by the use of mirrors takes both sides of a card in one operation. The cards pass between a pair of mirrors at 45 degree angles above and below the flat surface of the cards. The images are projected from either side of the card in the mirrors and are photographed as the cards whizz past.

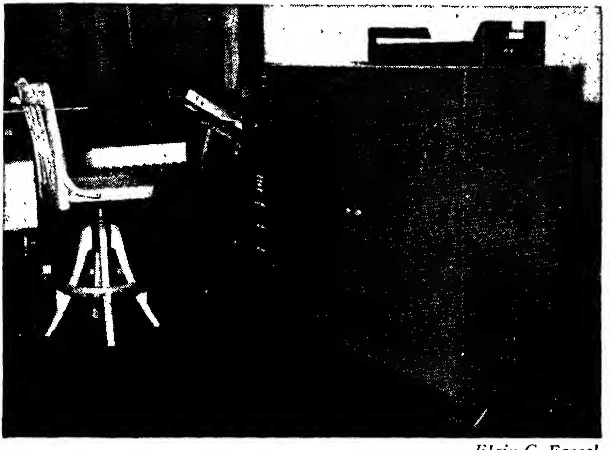
Files housed in a room 50 by 100 feet are compressed by Fassel's cameras to a small eighteen inch wide, five foot high cabinet containing six million microfilms of the subject matter of three million cards, front and back of each. A recent photograph shows Mr. Fassel and his containers of microfilm in front of a truck full of

baled paper shreddings. The truck holds nine tons of records, accumulated over 85 years and comprising 50 bales or 750 cubic feet of company cards which he photographed front and back. Before the truck, on a little table, are the microfilms which occupy only one and one-half cubic feet of space—a condensation of more than 99 percent.

Even more spectacular, considering that while Fassel began in 1934 his machine did not begin operating until 1939, is the fact that in October, 1943, he reported that more than thirty million photographs had been made. Where formerly filing cabinets occupied working space equivalent to the area of three average 6-room houses, today the same records are filed in 822 film containers occupying less than four cubic feet, the capacity of a small electric refrigerator.

Lt. Joseph P. Brennan, U.S.N.R., Officer in Charge, Microphotographic Service, Navy Department, writing in *The Journal of Documentary Reproduction*, aptly subtitles his article on microfilming, "Machine Tool of Management." Succinctly and accurately he remarks:

"Compared with tabulating and punch card machines, dictaphones, photostatic and other



Elgin G. Fassel

The Fassel Microfilm Camera photographs both sides of a document simultaneously. Its manufacture, license, and patent exploitation is controlled by the Microstat Corporation.

duplicating processes and similar mechanical aids, the modern technique of microphotography is in its infancy. Scarcely a dozen years have passed since this new tool was adopted by private industry as a means of improving old and established procedures. In that dozen years, however, it has become an essential part of the daily routine of over 9000 commercial firms and numerous agencies of federal, state and local governments.

"Banking institutions were foremost in the application of microphotography to their records problems. Microphotographs of checks provide the bank with a proof of checks received and paid, and provide the customer with a legally acceptable record in the event his canceled checks are lost or destroyed. Transit departments of banks have found that photographing checks drawn on banks in other cities eliminated the costly procedure of recording these checks by hand or typewriter. Bookkeeping departments formerly posted to a ledger and then to a statement to prove the first operation correct and to provide the customer with a record of his transactions. Today many banks post only one record, microfilm it, send the original to the customer as his statement, and

keep only the film as their record. Over a period of years the savings resulting from this single posting have been estimated to be approximately 35 per cent in posting equipment, 30 per cent in labor, 50 per cent in stationery and 30 per cent in space occupied by original records.

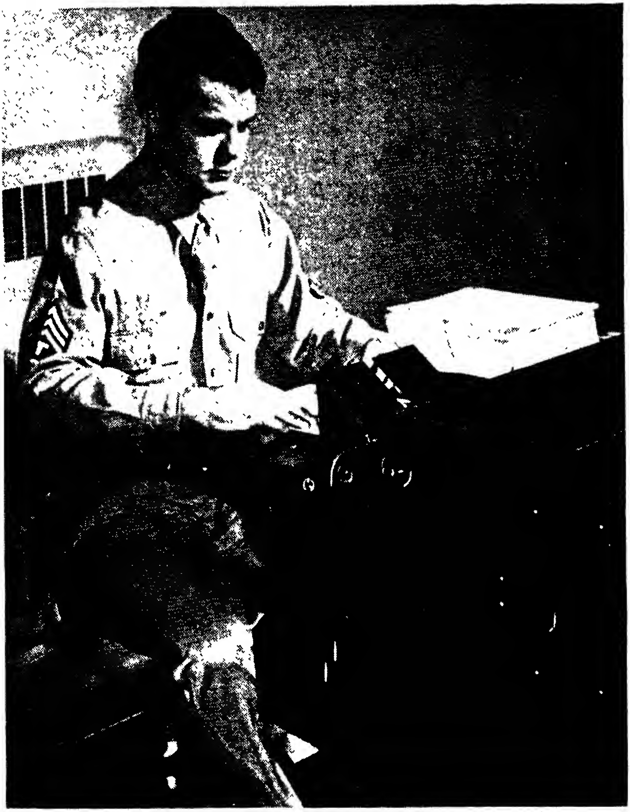
"Railroads have applied microphotography to their system of waybill recording. In the past when a freight train pulled into a yard, the conductor dispatched his reports to the terminal. The train waited until all necessary information was transcribed from waybills. A large complement of clerks was needed to speed up this process as much as possible. Emphasis on speed, however, only made for numerous errors which had to be corrected at a later date. Under the procedure now used by a number of roads the conductor hands his reports to a clerk who microfilms them in a few seconds. The reports are returned to the conductor and the train is cleared. In some yards the train never stops; the reports are sent from one end of the yard in a pneumatic tube to the terminal, microfilmed and returned in like manner to the other end where they are picked up by the conductor. The developed film is forwarded to the

central accounting office where the information is transcribed from film readers.

"Private industry has also utilized microfilming to insure and protect its records. Most of the big automobile and engineering firms have done this for years. Hospitals, insurance companies and others have microfilmed their records to save badly needed space.

"For some time prior to the attack on Pearl Harbor measures were well under way to provide security copies of vital naval records. The Navy Department has constructed a microfilm vault where security copies are stored.

"V-mail, patterned after the British (Airgraph) system, was recently put into effect by the War and Navy Departments. Its operation can perhaps best be described by the following example: Private John Doe in Dutch Harbor, Alaska, wishes to write his wife in Washington, D. C. He obtains a special V-mail form from the camp and writes his letter thereon. The form is folded, sealed, and sent to the post office where it is microfilmed on 16 mm. film. The developed film is forwarded via air mail, and the original letter is retained at the sending point until the film has arrived safely at its destination. If the film is lost in transit the



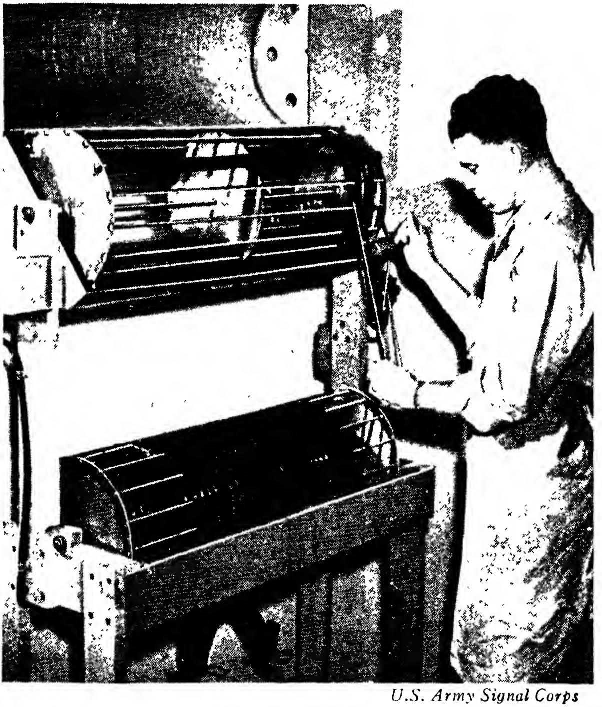
U.S. Army Signal Corps

Microfilming V-mail letters.

letter is rephotographed and the film again sent via air mail. In this manner safe arrival of the letter is eventually assured. A photographic paper facsimile of Private John Doe's letter is made from the film, placed in a small window envelope and mailed to Mrs. John Doe in Washington, D. C.

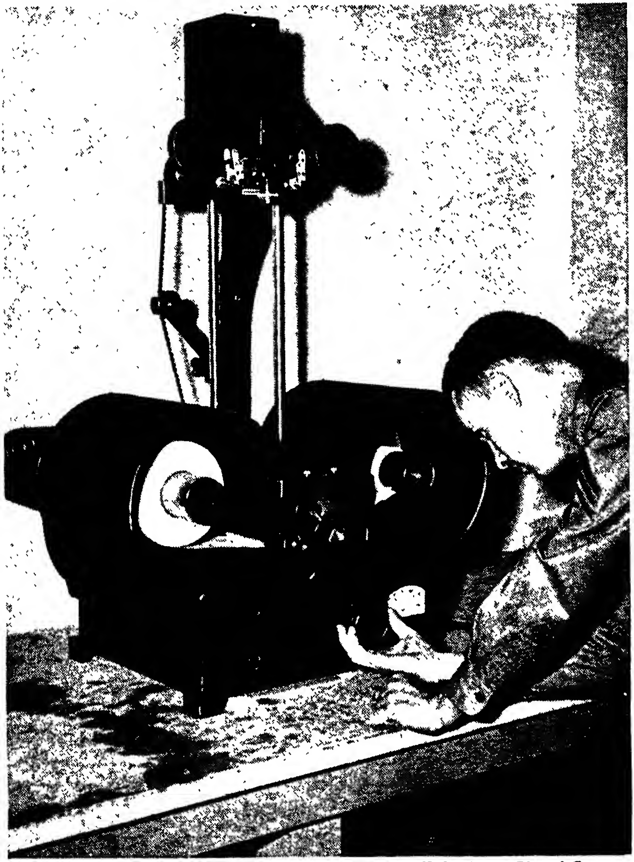
"The savings under this system are obvious. The average size canvas mail pouch will hold approximately 3000 letters weighing approximately 65 pounds. The same 3000 letters can be placed on two reels of microfilm weighing 15 ounces, a ratio of slightly more than 1 to 65. The maximum load for a large clipper is 3000 pounds, the equivalent of 46 mail pouches or only 138,000 letters. The same weight on microfilm totals 9,600,000 letters. With V-mail one plane can easily carry a load which otherwise would require at least 65.

"Recently a particular office in the Navy Department in setting up a case file found it necessary to duplicate 400,000 3 x 5 forms. To type this file would have occupied a very large crew of typists for several months. Two microfilming machines have been installed and, using each two shifts per day, the project will be completed in approximately one week."



U.S. Army Signal Corps

Processing V-mail microfilm. The 16mm Microfilm is developed, fixed and washed on the lower reel. Before drying on the upper reel it is sponged.

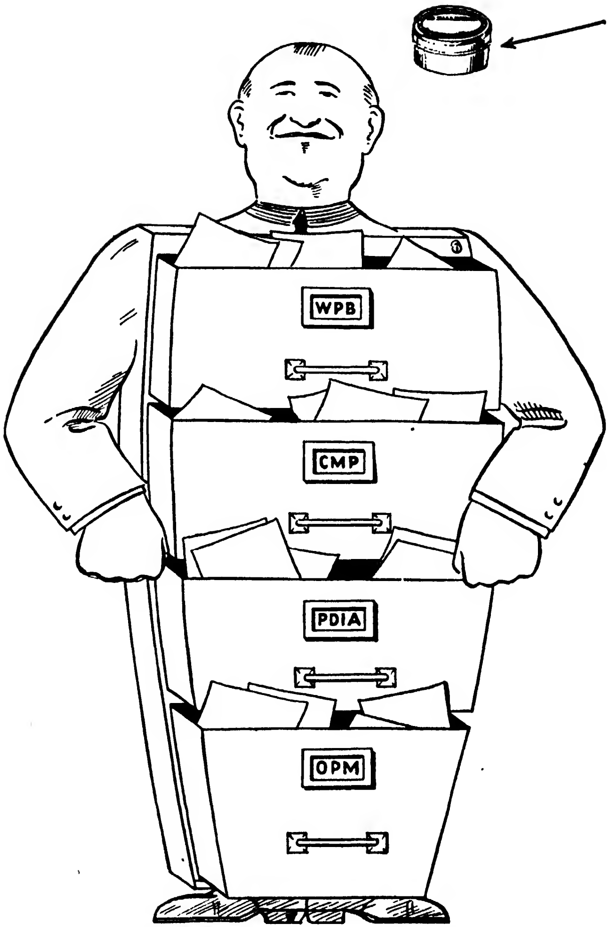


U.S. Army Signal Corps

Enlarging V-mail microfilm on an Airgraph continuous paper roll easel synchronized with the moving microfilm projected.

U.S. Army Signal Corps

Continuous paper processing machine speeds V-mail overseas.


WPB
CMP
PDIA
OPM

This is a Microfilm File containing all the records in the 4 drawer-file shown.

PR 1

INTERPRETATION 6
AUGUST 14, 1943

WAR PRODUCTION BOARD

PART 944—REGULATIONS APPLICABLE TO THE OPERATION OF THE PRIORITIES SYSTEM

[Interpretation 6 of Priorities Reg 1]

MICROFILM RECORDS

Records required to be kept by § 944.15 of Priorities Regulation No. 1 or by any other order or regulation of the War Production Board may be kept in the form of microfilm or other photographic copies instead of the originals.

Issued this 14th day of August 1943.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

Microstat Corporation

The United States Army and Navy also use microfilm to compress voluminous records. Duplicate films are flown to bases all over the globe or tucked away aboard air transports and warships. Ready reference is available for technicians in China who may have to reconstruct a plane wing, engine, or landing gear. Microfilm is flown to the rescue, projected on the side of a hangar, ship's bulkhead, or tent—the technicians proceed unhampered by rolls or folds of clumsy blueprints. In an emergency microfilm may be read with a magnifying glass.

Legislative and government rulings likewise favor microfilming. Public Law #115, approved by the 78th Congress, provides for the microfilming of all government records. The Wage and Hour Division of the Department of Labor and the War Production Board have also ruled that all records they formerly required of employers, prime contractors, industry and business in general, may be destroyed if preserved on microfilm. The Treasury Department interprets its tax rulings to the effect that microfilming is a deductible item, a necessary operating expense of a firm's business. Courts construe microfilm to have equal weight as evidence as original records if the originals are not available.

Chapter IV

MICROFILM CAMERAS

Microfilm apparatus needs taste in styling, coloring, and in the creation of product appeal. Surely no microphotographic unit of the 'forties retains any of the more obvious crudities to be seen in apparatus constructed in the 'thirties. Design improvement is necessary in both the internals and externals. Good functional design is predicated on externals reflecting internal needs and not vice-versa. This esthetic dictum is making itself felt more and more in the microfilming field. While design is also a function of manufacture it must emerge from the laboratory hand in hand with research results. Unless this wedding of forces is made in the laboratory we find a product not only ugly and even monstrous, but often a product wasteful of human motion and basic materials. Hence more and more types of microfilming equipment, that is, really efficient equipment, are either semi- or fully automatic, motor controlled mechanisms fabricated from the lighter non-ferrous metals and the newer plastics.

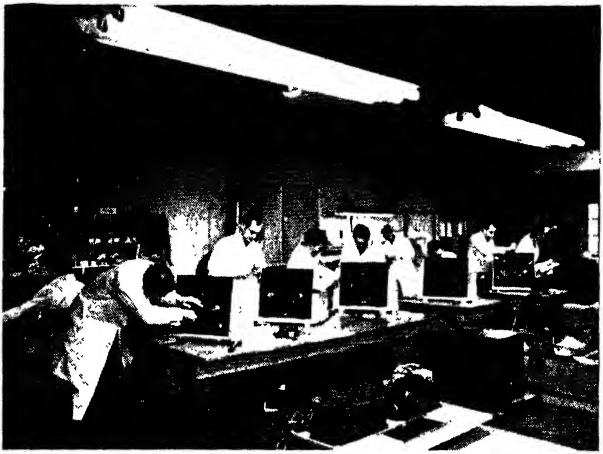
The search for perfection in precision micro-

filming is spurred on principally by the force of commercial competition, and by every microphotographer's pride in his science. The ideal is unobtainable only so long as research lags or production fails to take heed of its findings.

The chief engineer of a modern microphotographic factory begins with his sheaf of fresh blueprints, his parts, stores, his staff of consultants, machinists, electricians, optical and photographic experts. He ends at the end of his assembly line—the shipping room. Microfilm cameras, projectors, enlargers, positive film printers, film processing tanks, film dryers, film inspection benches, are but a few of the major items produced. A host of supply items and precision measuring instruments are also found in the production schedule of the complete microfilm factory.

A survey of the various microfilm camera and equipment manufacturing operations reveals the following job categories: metal shapers, die makers, tool makers, welders, instrument makers, electricians, painters, carpenters, cabinet makers, machine tenders, lens grinders, assemblers, storekeepers, inspectors, shippers, expediters, foremen, as well as chiefs, assistants, and apprentices in almost all departments and sections.

In the microfilming machine shop, as in its



Microstat Corporation

Assembling microfilm printers in modern microphotographic machine shop.

research laboratory, ordinary skills must be completely adapted to the special tasks presented in building high precision microphotographic apparatus. Tolerances are necessarily close, micrometer measurements are extremely critical and machine finish is paramount. A careless file cut or half soldered connection is costly. Undetected errors result in costly breakdowns. Accidents have a perverse way of occurring hundreds of miles from the factory and even far from the first-aid tool kits of the microfilming servicemen. Too often their causes may lead back to the machine shop, the assembly line. Fixing the blame is not nearly as important as preventing the recurrence of the accident. Responsibility and reliability therefore are high among the employment criteria applied in the hiring of technicians who wish to help build microfilming cameras, parts, and equipment.

Microfilming cameras are either manually controlled, semi-automatic, or fully automatic. In commercial practice the manually controlled camera is definitely limited and is barely adequate for even the smallest tasks. An Eastman 35, an Argus, Leica, or Contax will serve as a copying camera in an emergency if, and only if, the operator is completely equipped with all necessary accessories and is highly skilled.

E. Leitz, Inc.

Microfilming with the Leica copying attachment requires critical focusing, even illumination, correct exposure, a steady tripod.

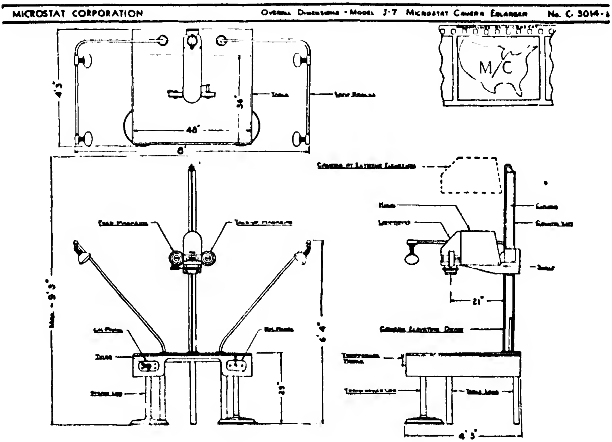
A microfilmer's day represents a fairly diversified work operation, involving attention to detail, and a feeling for the value of the copy being microfilmed.

Microfilm operators may be asked to travel with mobile camera units from one office to another, one factory blueprint room to another, one city to another. However, as some equipment is fully automatic and installed on a rental or service basis, an operator may find himself located in one place for a considerable period of time. Some of his work involves training green-hands in simple camera feeding operation; sometimes he may merely be sent to install a piece of automatic equipment in the office of a customer. In any case, his advance from apprentice operator, through the ranks of assistant, to operator, and finally chief operator, may be fairly rapid, with commensurate rewards in pay and opportunity.

After the microfilm pictures have been taken they must be available for reference. There are two ways to examine these pictures or to make them part of a permanent filing system:

(a) Enlarge each frame of film to any required size or to exactly the original size, and make a reproduction on paper, cloth, or acetate.

(b) Make positive film from negative film. The positive film can then be made into individual transparencies for projection or into eight-frame strips for filing in standard microfilm envelopes or kept intact in roll form.



Microstat Corporation

A 24 by 36 inch tracing greatly reduced for Kardex filing.

ASSEMBLING THE CAMERA

First Steps:

1. Have ample head room and floor space at spot where unit is to be assembled.
2. Try to leave walking room between unit and walls at either side. Leave room to accommodate feed tables.
3. Check the current. A 110-115 volt, single phase, 60 cycle 30 ampere supply is usually necessary; be sure it is AC or that a current convertor is installed if needed.
4. Special Caution: Never plug Alternating Current cameras in on Direct Current unless this is previously converted.
5. If the camera is received in crates unpack and arrange crates neatly and place them to one side.

Assembling:

1. Set camera cabinet or frame on a level floor in a location free from vibration.
2. Install camera head; be sure to seat the joint perfectly.
3. Install necessary bolts and springs or check for accurate positioning.
4. Connect electrical power plugs.

5. Level camera by adjusting legs. Be sure to tighten lock nuts.
6. Place transformer unit or control cabinets in position.
7. Place table on tripod frame of camera or adjust feeding shelf.
8. Clean and check over lamp sockets.
9. Insert all holding bolts, clevis pins, cotter pins required.
10. Level and secure camera in operating position.
11. Install photoflood or other illumination lamps and level.
12. Connect all wires to rear of panel boxes, being sure operating and lamp switches are "off."
13. Install dimmer arm or transformer handle knob if provided and adjust so handle is perpendicular at working light. Caution: Dimmer arm must not touch panel.
14. Connect power line to suitable supply (usually 110-115 volt, 60 cycle, single phase, 30 ampere, AC). Never plug the camera into DC unless power has been properly converted.
15. Test camera's mechanical operation.
16. Check leveling on table type cameras by

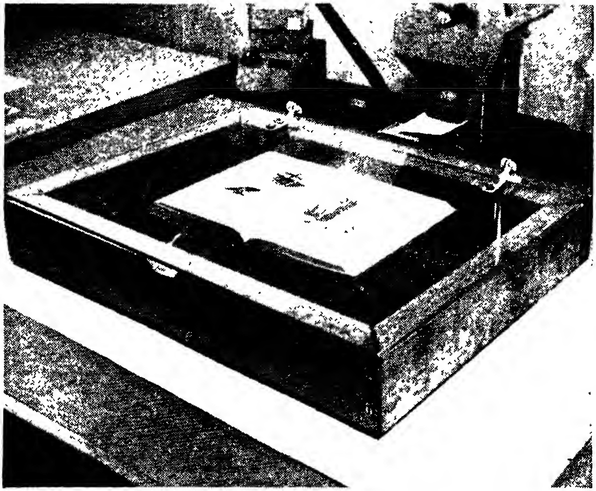
measuring the projected image at top of column. Level lighting by use of the incident light meter.

17. Run calibration tests for all coverages, taking three frames for each coverage. Check the four calibration points. Read and log each carefully. Calibrate light meters by running density test.
18. Tidy up the camera room. Neatness promotes efficient operation.

LIGHT CONTROL:

1. As shown in the illustration, there are usually two kinds of light meters. The incident light meter, measuring light directly from its source, is used to "level" the lights on table cameras by checking the intensity of light at all four corners and in the center at a reading of usually, 200 foot-candles, and to find the amount of light necessary to shoot dark copy like black title blocks, blueprints, and Van Dykes. The proper amount of light for dark copy is always determined for each job by exposure tests.

2. The reflectormeter, which measures light reflected from the copy, is often used for all other light-control purposes on table cameras where variable lighting is provided. The ultimate sim-



The Microfilm Corporation

Book cradle and multiple cell reflectormeter. Incident meter and exposure counter are directly to left of reflectormeter.

General Electric

G-E Exposure Meter, type DW-48, all-purpose design.

plicity has been achieved here, for the operator needs only line up the indicator arrow with a line at the center of the reflectormeter dial face. The reflectormeter must be calibrated by a test strip at the start of each job. Two types are available: the simple single meter such as used on Recordak Micro-File cameras and Microstat All-Purpose equipment and the more sensitive five meter assembly made by The Microfilm Corporation.

3. The Incident Meter and Adjustment of the Reflectormeter. The operator controls lights with the dimmer at all times, regardless of which meter he uses. He moves the dimmer arm or transformer handle clockwise to raise the lights, counter-clockwise to lower them. A complete semi-circle counter-clockwise will turn the lights off altogether for the shooting of "blanks." But for other than brief blackouts, the operator must turn off his lights by turning off the lamp switch. Caution: Before turning on the lamp switch, the operator must be sure his dimmer is turned to "low" because turning on lamps suddenly at high level materially lessens their total life and their immediate even quality. Turning lamps on or off when dimmer is turned to "high" is dangerous.

The General Electric foot candle exposure meter is particularly adaptable to microfilming

in that it is the only meter designed to measure incident light. That is it will measure the light falling on the surface while the calculator is so arranged as to compute the exposure from this measurement. This can be accomplished by removing the directional hood and holding the meter on the copy-board. This gives the correct exposure. The incident light method of measuring exposure will permit the measurement of exposure from any type of copy material such as copying material with a white background or black background.

4. Density Test. Density is the amount of silver remaining in the emulsion after film has been processed. It depends on exposure; exposure to a large amount of light produces a dense negative; less light produces a negative of lower density. It is especially desirable that microfilm have a relatively high density, ranging at the extreme limits from 0.8 to 2.5. The preferred density of a line copy negative is 1.6 although some microfilmers prefer a thinner negative of about 1.2. On jobs where the kit includes a densitometer,* the operator takes a density reading by placing the

* The text refers to the Eastman and the Marshall densitometers. Ansco-Sweet direct reading densitometers are quicker to operate but more costly.

frame of test copy over the window of the densitometer, with the solid background of the copy itself centering on the hairline circle of the window. Then he turns the control knob or disc until, through the eye-piece that he drops into place, he can see a white dot. Further turning of the knob or disc makes the white dot turn into a black dot. By adjusting between the white dot and the black dot he achieves a blending between the two where no dot at all is visible and sees an even tone over the whole field. At this point he looks at the side of the densitometer and notes where the indicator has come to rest on an illuminated scale. The arrow points to the figure that represents the density. Equivalent results may be obtained by comparison of test strips with film samples of known density.

5. Large Drawings. In large drawings, which must be exposed in sections, shoot each frame at the same average lighting, regardless of how much the density of the actual copy may vary. Do not move the dimmer arm, change the voltage or otherwise alter the lighting.

THE TEST STRIP:

1. Test strips are made and developed at least once a day. The test strip is essential insurance

against faulty microfilming. It shows the date taken and all other necessary details on the correctly filled out title block. It is to be carefully read and the results recorded in the operator's log. The strip is then filed by the operator as a permanent part of his log; it will be inspected by his supervisor at frequent intervals.

2. Standard Sequence of Frames. The test strip should contain the following frames in the given order:

(a) 10 blanks.
(b) Title block (identification chart).
(c) Test chart.
(d) Background at operating light level.
(e) Test copy (usually first piece of copy on job to be done).
(f) 10 blanks.

3. Removing the Test Strip from the Camera. Since the test strip is to be processed by the operator immediately, the following steps are frequently standard:

(a) Place tank, tank cover, developing reel, and scissors (or knife) under take-up magazine (or in changing bag).
(b) Turn dimmer arm down until lights are out, then turn lamp switch off. (If using

bag, check fastenings and turn dimmer low).

(c) Remove cover from take-up magazine.

(d) Cut film at guide roller; remove film from take-up spool.

(e) Insert end of film in reel, pushing until all of strip is in.

(f) Cut off excess film if any. Never try to develop more than four feet of film in operator's tank.

(g) Place reel in tank and put tank cover on securely.

4. Process as instructed.

5. Inspecting the Test Strip. If there is anything wrong with the test strip, the operator can do intelligent trouble-shooting in terms of what the test tells him. His inspection covers the principal elements that the plant inspector will check on the finished roll:

(a) Light Level—Check to see if the test frame is an even shade from corner to corner and from center to corners.

(b) Vibration—Check to note blurring of lines in the resolution chart.

(c) Background—Check to insure smooth, clean appearance and to catch smudges and wrinkles, however slight.

Edwal Laboratories

Loading microfilm on test strip tank reel.

Edwal Laboratories

Method of pouring developer or fixer into test strip tank. Agitate film with twirler shown in front of tank.

(d) Density—Compare with three standard samples. Good density for line copy work (drawings, maps, etc.) is 1.6; 0.8 is lowest limit; 2.5 highest limit. A good operator will hold his density much closer than these limits.

(e) Resolution—Test to check standard requirements of 65 lines per millimeter or better at all points.

STEPS IN FIELD PROCESSING:

1. Reels should be cool and dry.
2. Strip should be loaded evenly into reel.
3. Temperature of developer should be exact. Any deviation affects density and does not give a true indication of correct exposure.
4. The developing tank should be immersed in water of proper temperature to a depth of about three inches; this maintains correct temperature during development.
5. Set clock for time limit of developer used.
6. Pour 16 ounces of developer continuously and smoothly into the tank through the light-proof opening in the lid; instantly start clock. (Tilting tank will speed the pouring).
7. Spin reel twice directly after pouring de

veloper. (Agitation should be in direction that will force film into reels).

8. Allow development to proceed without agitation for correct number of minutes.
9. Thirty seconds before clock is due to ring, start pouring developer out. Bell should ring about the time the tank is completely emptied.
10. Pour in 16 ounces of hypo and agitate for ten seconds.
11. Leave reel in hypo for five minutes.
12. Remove reel from tank and pull top of reel out to release film.
13. Allow film to wash for 5 minutes in running water.
14. Sponge film carefully and hang up to dry, using film clips.
15. Clean up all processing equipment thoroughly.
16. Caution: Never use developer twice.

A prominent microfilming firm writes concerning coverage:

"We sell microfilm negatives to our customers for the protection of their valuable records. We . . . urge that the job be done correctly and only then that cost be consid-

ered. We recommend the largest coverage we believe to be safe. If the customer insists on a greater coverage he must assume responsibility for the resulting quality. It may be adequate for his needs if his copy is of no great importance, but we must . . . advise him of the danger of imperfect reproduction.

"In line with the above we have adopted several standard coverages to be used in accordance with the best judgment of our sales engineers and production supervisors. Their recommendations in the case of each customer are made after a careful survey of the copy to be microfilmed. A survey report is approved by the customer and then incorporated in the written instructions to our camera operators.

"The Standard Coverages are:

A size, for copy not over 9″ x 12″
B size, for copy not over 12″ x 18″
C size, for copy not over 18″ x 24″
D size, for copy not over 24″ x 36″
E size, for copy not over 36″ x 48″

"If the copy to be microfilmed is difficult, yet of large size, it is often necessary to microfilm it in sections just as an aerial map is made. The exposures overlap so that collectively they

fully reproduce the original copy. If necessary, composite enlargements can be made to re-create the original in one piece from the several sectionalized microfilm exposures.

"Coverage is the area microfilmed at a particular height and focus with clarity and precision. The higher the camera head, the larger the coverage; the lower the camera head, the smaller the coverage.

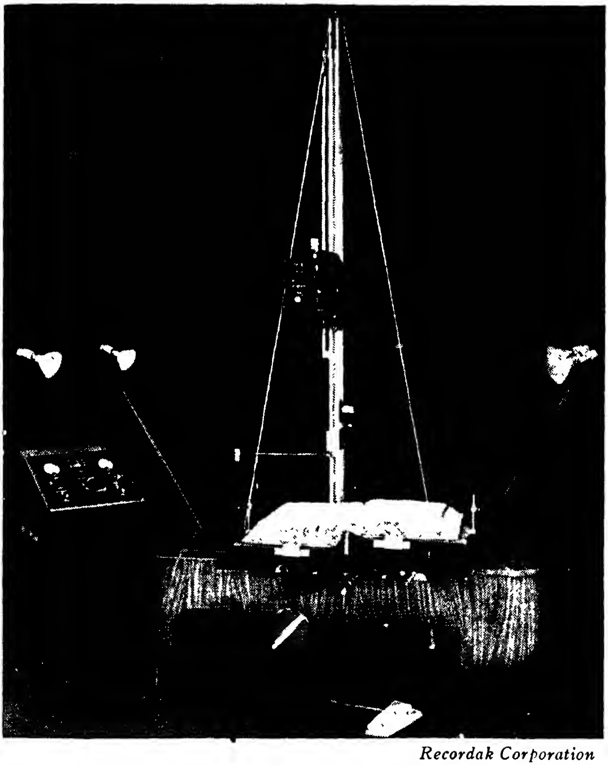
"Naturally every customer would like his work done at the largest coverage, because that gives him fewer exposures and a smaller bill for our services, and we will gladly accommodate him whenever we can. This page is designed to tell you just why we cannot do so in all cases.

"It will be obvious to you that we can take a picture of a billboard 20 ft. long with a dollar camera and read every word of it on the resulting picture, but if you tack a newspaper on the same billboard you cannot read it in the Brownie picture. In one case the individual type-characters are a foot high, and in the other they are a thirty-second of an inch high. You must always remember that the size of the smallest character on the copy limits the coverage you can use.

"Other factors are also important in deciding what coverage can be used. For instance: if the paper is very white and the ink is very black you can use a greater coverage than you can if the paper is soiled and the lines have been made by a hard pencil and then smudged by handling.

"Of course, it is cheaper for the customer to put several small pieces of copy on one exposure of large coverage, but if the several pieces of copy are of different colors each requires a different amount of light to make the correct exposure. If both are exposed at once you cannot have the correct lighting for both and the resulting negative will be faulty."

Best known and longest in use are the Recordak cameras which have been ably designed for handling all types of copy, for meeting the varied needs of photoduplication. Largest Recordak camera is the Micro-File Model C shown here as set up to photograph a bound newspaper volume at a speed of fifteen pages a minute. A book cradle is provided for moving books from one side to the other, for keeping both sides level. Lighting is from four photoflood lamps controlled by the instrument panel at the left of the camera



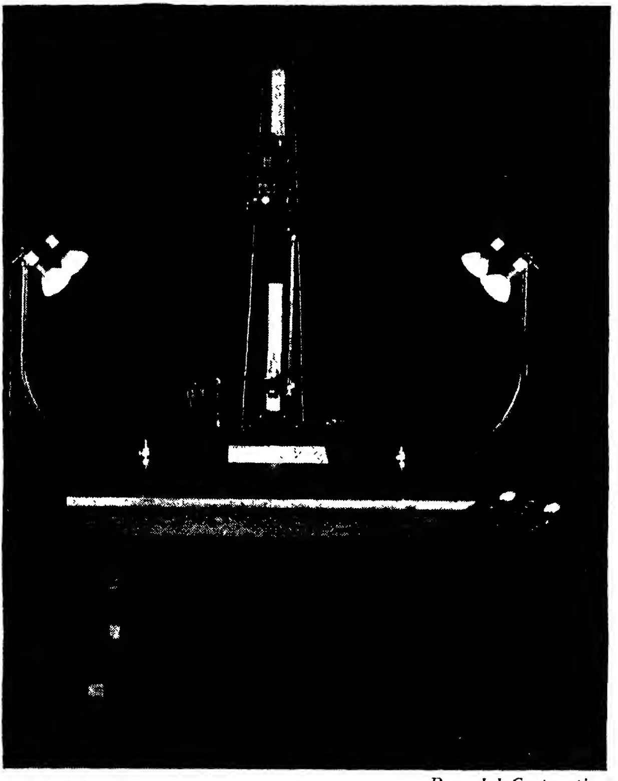
Recordak Corporation

Micro-file Recordak Model C Camera photographing a huge bound volume.

table. A large geared wheel adjusts the height of the camera head in relation to the table. Draw strings alter the film frame size to fit the shape of the copy, thus conserving film. Focusing is automatic. Light changes are accomplished by a meter swung out on an arm affixed to the upright column. Exposure, as in the Microstat J-7 and the Graflex Photorecord, is controlled by a foot pedal. A somewhat similar Recordak camera is provided with electrical controls on the front apron of the table which is further provided with adjustable hold-downs for handling large maps and engineering drawings. Film used is non-perforate 35mm. In order to make enlargements, however, an enlarger is required. The Eastman Precision Enlarger head has been adapted for this work on a wall type of mounting.

Somewhat smaller but nearly as useful is the Recordak Micro-File Model D. This relatively compact unit is placed on a table top with the control panel assembly set nearby for the convenience of the operator. A wide range of bound and unbound material can be photographed on either 16 or 35 mm microfilm.

Another popular camera is the Commercial Recordak used to microfilm letters, cards, checks, commercial size paper. Insurance cards are being



Recordak Corporation

Micro-file Recordak Model D Camera uses 16 or 35mm microfilm.

Recordak Corporation

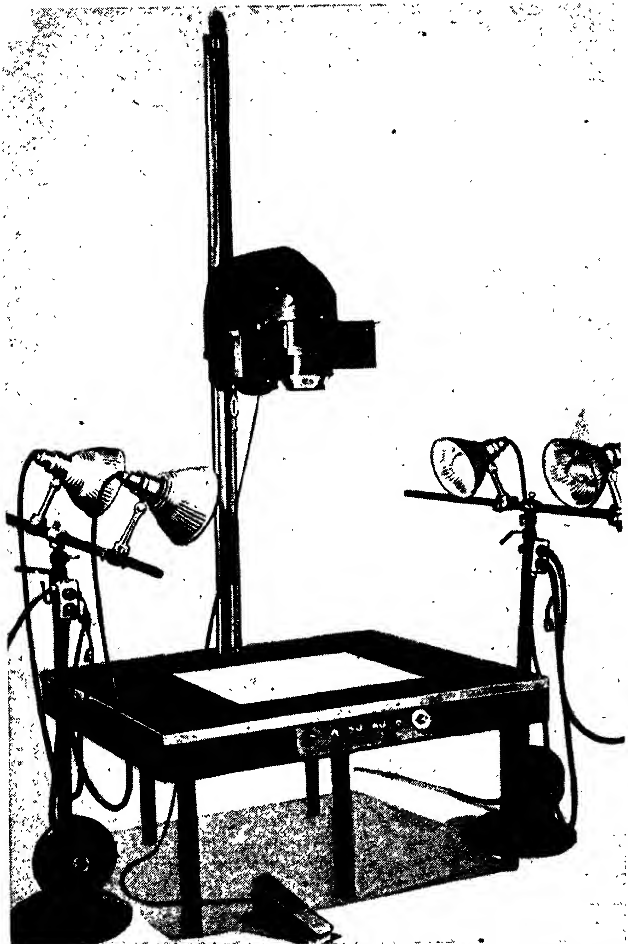
Commercial Recordak Camera microfilms 4800 cards on a 100 foot roll of film. Cards are hand fed, photographed within the cabinet, dropped into a hopper in the same order.

fed into the model illustrated. These records can be filmed as rapidly as 100 a minute and about 4,800 cards are condensed on a 100-foot roll of film.

Recordak Corporation

Recordak Junior Camera-Projector aids accounting in many banks and offices.

Smallest but most versatile of Recordak's units is the Junior. This compact desk model is a combination camera and reader. Documents up to legal size can be handled at the rate of 45 photographs a minute by fast operators. Smaller commercial organizations usually employ this Recordak Junior on a monthly rental basis.

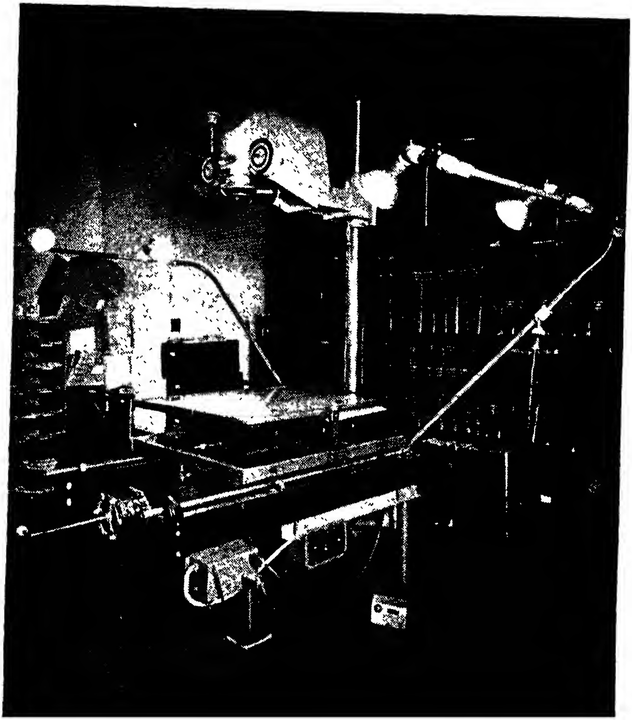


Microstat Corporation

First Microfilm Camera-Projector built in 1937.

Microstat Corporation

Microfilm Camera-Projector by Microstat, Model J-7 B. Meters at rear of table measure light, determine correct exposure. All controls are electrical and speed precision performance.



Microstat Company of California

Microfilm Newspaper Camera-Projector, Model J-7 C, recording 63 years of history reflected in the pages of *The Los Angeles Times.*

The Microfilm Camera-Projector by Microstat is electrically controlled and is designed to insure rapid and comfortable operation as a microfilm camera or as a projector-enlarger. Film used in all the early models of this apparatus is 35 mm single perforate. Recent camera-projectors have been constructed to accept 35 mm non-perforate film.

Microstat's Model J-7 Camera-Projector operates at reduction ratios ranging from two to thirty-two diameters and this versatile precision equipment has been produced in an alphabetical series with J-7 A designating an all-purpose apparatus fitted with a 60 mm Goerz Dagor lens. The J-7 B contains a number of improvements; notably full control of the projection lighting circuit and the choice of either a 50 mm Eastman Ektar lens or the 60 mm Dagor. Camera-Projectors fitted with the 50 mm lens will take copy or project an image up to 36 by 48 inches. The 60 mm lens assembly allows for copying and enlarging up to 24 by 36 inches.

The J-7 C was specially built by the Microstat Company of California to microfilm large bound volumes of *The Los Angeles Times*, other newspapers, and libraries. The J-7 D is being constructed by The Microfilm Corporation to auto-

Pathescope Company of America

Microfilm Fixed Focus Camera-Projector by Microstat, Model J-8, reproducing state, county, and municipal records.

matically feed large or small copy at high speed. The latest Microstat improvement makes it possible to project microfilm in a fully lighted room. The daylight projection feature is offered in the J-7 E. An air-cooled 1000 watt Radiant lamp furnishes the necessary illumination which also makes the levelling of lenses an easier and quicker task.

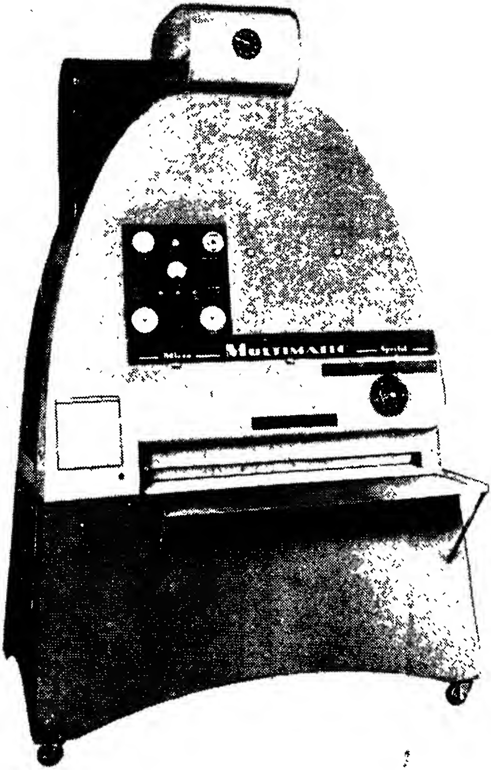
The right to develop and otherwise exploit the automatic-feed, high-speed Fassel 16 and 35 mm office camera and its patents is now controlled by the Microstat Corporation. This remarkable office machine will simultaneously photograph both sides of a bank check, index card, ledger sheet, or standard letter at the rate of 150 to 200 pieces per minute, depending on the nature of the copy.

The Folmer Graflex Corporation, long famed among amateur and professional photographers for the Graflex and Graphic cameras, produces the Photorecord microfilm camera. The Photorecord is appreciated by mary because of its compactness, portability, simplicity of operation. It weighs but 42 pounds, comes complete with base which is also its carrying case containing a separable upright column, lighting system, foot pedal, camera head, 75 mm f 3.5 lens and shutter,

film magazine for 35 mm double perforated film, focusing panel, etc. Focusing is by inspection of a removable ground glass or by projection from a special light provided on models made after August, 1940. Later models also employ R-2 photoflood illumination.

Photorecord accessories especially recommended are an air compressor for increased ease and speed in making exposures. The regular air pump foot pedal supplied, moves the shutter and actuates the film transport within the head. Fairly large size legal documents and books can be copied with this camera whose base is 20 x 22 inches. The Photorecord book cradle is extremely useful as it makes for ease in handling bound volumes. It accommodates open books as large as 19½ x 26 inches. Adjustable spring supported platens automatically compensate for the varying thickness of the books being microfilmed. Additional Photorecord design features permit the use of 2¼ x 3¼ Graflex film and plate holders when copy negatives of larger size are required.

Directions for microfilming with the Graflex Photorecord follow:



Graphic Microfilm Service Inc.

Graphic Micro-Multimatic Special Microfilm Camera for photographing large copy. Engineering tracings up to eighteen feet in length have been microfilmed on one continuous negative by this machine

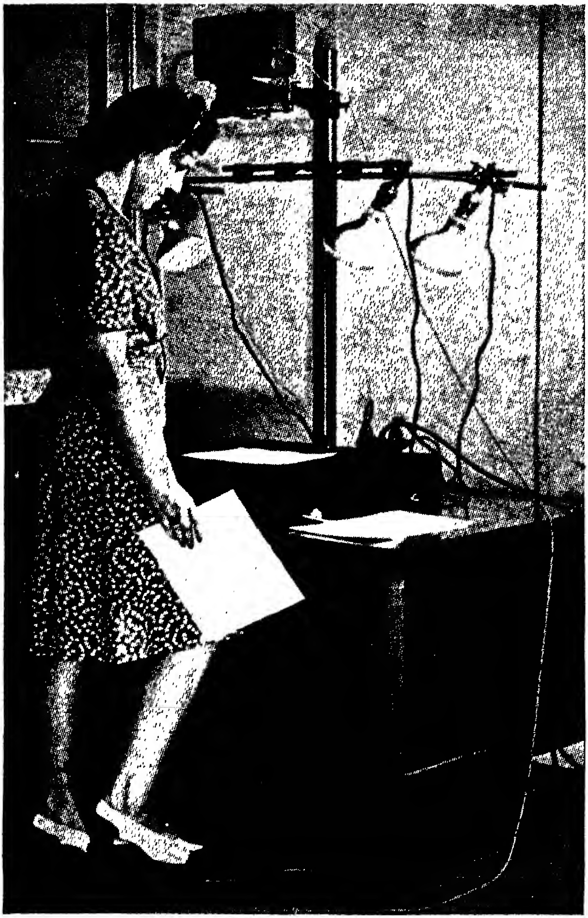


FIG. 1. The Photorecord in use.

The Photorecord is a simple, portable outfit designed for the efficient quantity production of microphotographic records on 35 mm film. It incorporates its own lighting system and is operated by air compressed by a foot-pedal or by a motor-compressor, or from a pressure cylinder.

The complete Photorecord Outfit includes the following principal parts:

A—Carrying Case, which also serves as a Base;

B—Column, to support the Camera **E** and Lighting System **C**;

C—Lighting System;

D—Camera Bracket for the Camera **E** and Film Magazine **F**;

E—Camera, including Lens **L,** Shutter **S,** and Ground-Glass Focusing Panel **E-6**;

F—Magazine, accommodating 100 feet of double-perforated 35 mm film;

G—Pneumatic System to operate the Camera mechanism; and

H—Lamp House for projection focusing.

The entire outfit packs in the Carrying Case as shown in Figure **2**; it is easily assembled and set up for use as shown in Figures **1** and **3.**

The particular features of the Photorecord are: its portability, the simplicity of its operation, its ability to photograph solid as well as flat objects, and the wide range of available reproduction ratios (from a reduction of 1: 1.5 to a focus on infinity). It makes 800 double-frame exposures (25 x 33 mm) or 1600 single-frame (25 x 19 mm) exposures on one loading of 100 feet of 35 mm film.

Packed in its Case it can be carried by one man, set up near any available 110-Volt power supply, and used by a relatively inexperienced operator for such diverse purposes as personnel identification, microfilming of documents, and the photography of stamps, coins, small-arms, and other solid objects possessing one fairly flat dimension.

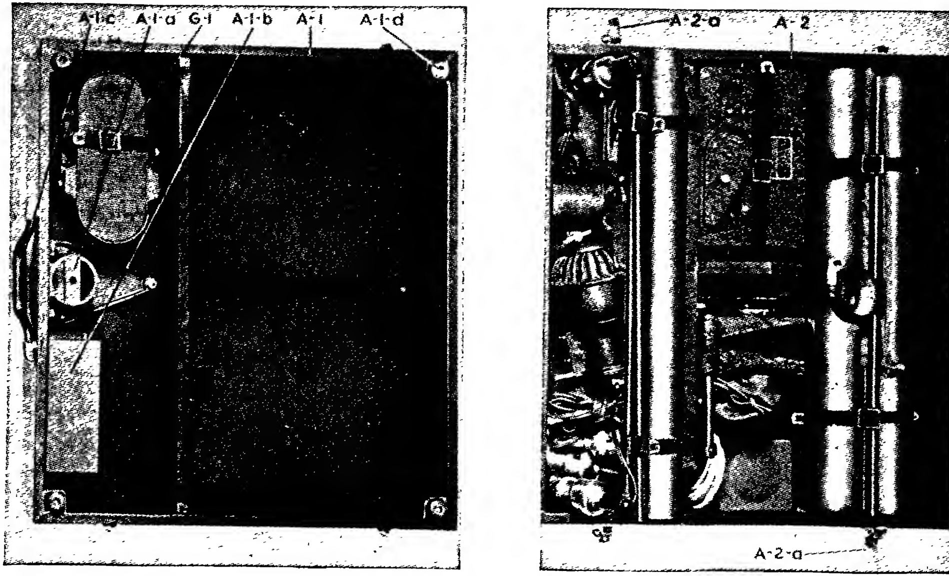


FIG. 2. The Carrying Case, packed

The **Carrying Case A,** Figure **2,** accommodates the complete Photorecord Outfit as illustrated. In use the **Cover A-1** of the Case (to which the Handle is attached) serves as the Base. The **Column B** fits into its **Socket A-1-a** in the Base, and there is an **Electrical Receptacle Box A-1-b** containing one **Input** (male) and two **Output** (female) **Receptacles** for the Lighting System. **Rubber Feet A-1-d,** at the corners, prevent skidding or damage to the surface on which it is placed.

The removable **Column B** (Figure **3**) comes in three sections, and supports the **Lighting Bracket C-1** and **Camera Bracket D.** The Lower Section **B-1** has an embossed ring near the end that fits into the Socket **A-1-a,** and in its other end is a small threaded socket to accept the bolt fixed in the lower end of the Middle Section; the Middle Section **B-2** has a similar small threaded socket in one end and a bolt in the other to permit rigid attachment to the Lower and Upper Sections; the Upper Section **B-3** has a bolt at its lower end and is open at its upper end.

The **Lighting System C** (Figure **3**) is supported by its **Bracket C-1,** which is a split-ring locked on the Column by the **Key-Screw C-1-a.** The **Center Tube C-1-b** is permanently attached to the Bracket. Four other tubes **C-2** and **C-3,** $\frac{7}{16}''$ in diameter and $20\frac{3}{8}''$ long, are arranged as shown in Figure **3** to support the four **Sockets C-4** for the 150-Watt R-40 Reflector Flood *(not photoflood)* **Lamps C-5.** The **Clamps** by which the tubes are held together permit adjusting the position of the Lamps to assure even coverage of a wide range of sizes of copy at all possible reproduction ratios. Assembly instructions are given below.

The **Camera Bracket D** (Figures **3** and **4**) is an arm and split-ring in one piece, fitting over the Column, with a **Key-Screw D-1** for tightening it.

The **Camera E,** (Figures **3, 4, 5** and **6**) which attaches to the **Camera Bracket D** with the **Camera Key-Screw E-1,** consists of a **Base E-2** to which are attached two parallel **Rods E-2-a** carrying the fixed **Camera Front E-3** and the movable **Camera Back E-4;** the **Bellows E-5** connects the Front and Back to form the light-tight Camera proper. The Camera Back is movable vertically along the Rods of the Base by means of the long-lead **Focusing Screw E-2-c.** The Shutter **S,** containing the Lens **L,** is attached to the Front. The Back (Figure **6**) incorporates a **Slide-Lock E-4-a** to permit ready attachment of the **Ground-Glass Focusing Panel E-6** and the **Magazine F.**

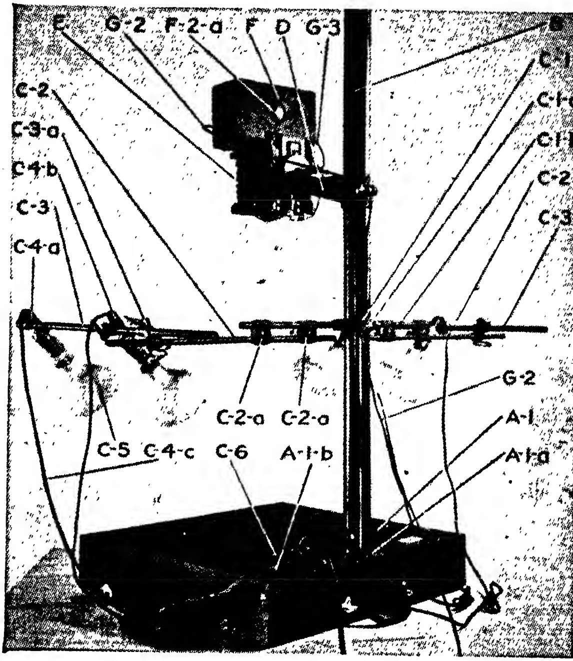


FIG. 3. The Photorecord set up for use.

The **Shutter S** (Figure 5) is a Heavy-Duty Betax No. 2, fitted with the **Shutter Cylinder S-2** for pneumatic operation, in addition to the regular **Shutter-Operating Lever S-3.** It gives automatic exposures of 1, ½, ¼ and 1/25-second plus Time and Bulb, according to the position in which the **Shutter-Speed Lever S-1** is set, and is designed especially to function with consistent accuracy over a long period without the need of adjustment. The Shutter is set in the shallow, circular metal Lensboard into which screw the **Locking Pins S-4** and

Shutter Cylinder **S-2**. Two Shutter Clips **E-3-a** on the Camera Front engage the Locking Pin **S-4** and the tube of the Cylinder **S-2,** to hold the Shutter in place.

The **Lens L,** (Figure 4) fitted to the Shutter **S,** is a **75 mm Graflex Photorecord f/4.5** of high resolving power, with an iris diaphragm and diaphragm scale calibrated in the standard system of relative apertures from f/4.5 to f/22, with the additional aperture of f/6.3. **S-7** is the **Diaphragm Lever,** used to adjust the diaphragm to the desired aperture.

The **Film Magazine F** (Figures 4 and 11) consists of a **Body F-1** with an internal mechanism to hold and transport the film, and a **Cover F-2.** It is fitted with an **Exposure Counter F-1-a,** and a **Slide F-1-q** (Figure 5) to prevent fogging of the film when the loaded Magazine is out of the Camera. It accommodates 100 feet of double-perforated 35 mm film on No. 10 Eyemo Spools, and is attached to the Camera Back **E-4** by the **Slide Lock E-4-a.**

The **Magazine F,** when loaded, appears as in Figure 11 before the Cover is attached. Instructions for loading are given below. The pressure of air from the **Foot Pedal G-1,** (Figures 1 and 7) acting on a Piston in the Magazine Cylinder (not visible in Figure 11) causes the rotation of the Drive Sprocket and Take-Up Spool that transport the film through the Magazine. Near the end of the Piston stroke, after movement of the film is completed, a vent in the Cylinder is exposed, through which air is fed to the **Shutter Cylinder S-2** (through the **Outlet Pipe F-1-d** and **Short Hose G-3**) to operate the Shutter and make the exposure. Movement of the **Film-Advance Control F-1-n** to either "1" or "2" regulates the stroke of the Piston for single-frame and double-frame negatives respectively.

The **Pneumatic System G** includes: the **Foot Pedal G-1** (Figure 7), and the **Hoses G-2** and **G-3** (Figure 3) carrying the compressed air from the Foot Pedal to the Magazine Cylinder and from the Magazine Cylinder to the Shutter Cylinder **S-2.** The Foot Pedal **G-1** is a foot-operated air-compressor consisting of the **Base G-1-a,** the hinged **Pedal G-1-d,** and the **Bellows G-1-c** which is compressed by movement of the Pedal. The Long Hose **G-2** is attached to the **Nipple G-1-b** on the Base and to the Magazine **Inlet Pipe F-1-c.** The Short Hose **G-3** leads from the **Outlet Pipe F-1-d** to the Shutter Cylinder **S-2** (Figure 4).

The **Lamp House H** (Figure 8) for projection focusing, attaches to the Ground-Glass Focusing Panel **E-6** by means of its **Locking Pins H-1-d,** which engage in the two **Lamp-House Clips E-6-d** (Figure 6). It projects a pyramid of light

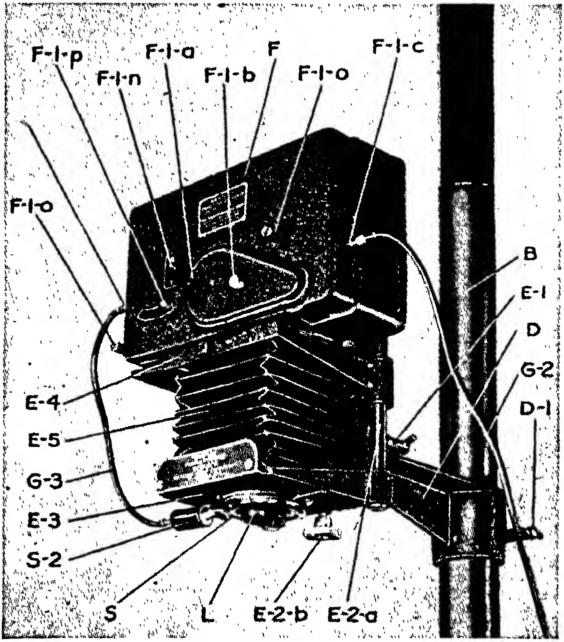


FIG. 4. The Camera and Magazine.

(Figure 9) that defines, on the Base of the Photorecord, the exact limits of the field covered at any reproduction ratio, as well as the image of two lines scribed on the Ground Glass used for critical focusing.

The **Lamp House** consists of the **Body H-1** and the Cap **H-2.** The **Lamp Socket H-1-a, Handle H-1-c,** and **Locking Pins H-1-d** are attached to the Body; the Cap fits smoothly into the Body and is easily removed by hand. The rubber-covered **Lamp Cord H-1-b,** attached to the Lamp Socket, has a standard household plug and an on-off switch. The Lamp House will accept either a 50 or 100-watt lamp designed to burn horizontally or base-down, with a double-contact bayonet base. The **G. E. 100-Watt, 110-Volt, S-11 Double-Contact Toy Projector Lamp** is suitable.

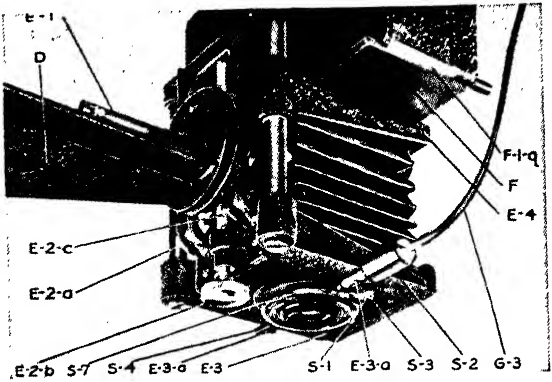


Fig. 5. The Camera front.

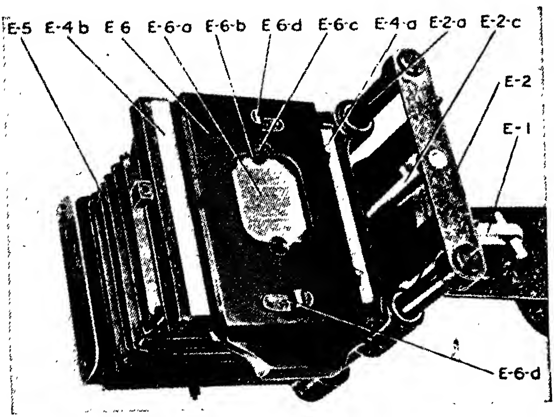


Fig. 6. The Camera back.

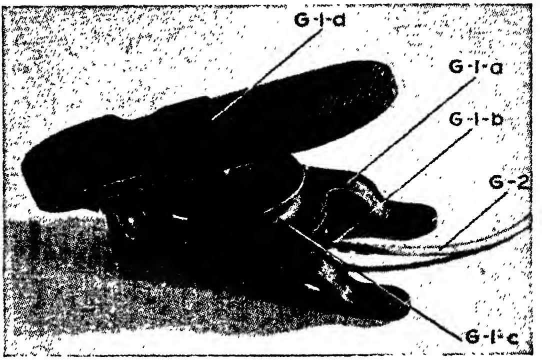


FIG. 7. The Foot Pedal.

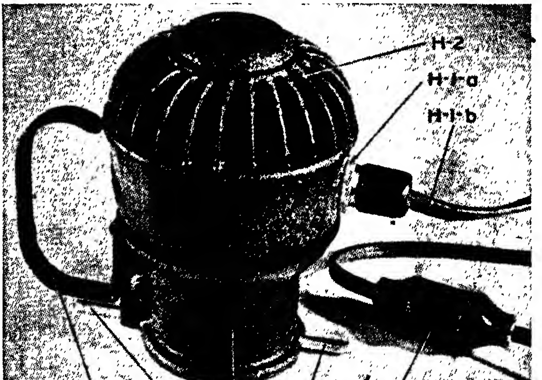


FIG. 8. The Lamp House.

Base

Open the Clamp-Locks **A-2-a** (Figure 2) at each end of the Case, and separate its two halves. Remove the Foot Pedal from the section **A-1** (to which the Carrying Handle is attached), turn **A-1** over so that its rubber feet are down, and place it on the work-bench with Column Socket **A-1-a** at the back. The Base is now ready for further assembly operations.

Column

Remove the three Sections of the Column from the Case **A-2**, and screw the Lower Section **B-1** firmly into the Socket **A-1-a.** Place on this lower Section first the Lighting-Support Bracket **C-1** with its attached Center Tube **C-1-b** toward the front, and then the Camera Bracket **D** with its flat side up. Screw the Middle and Upper Sections of the Column firmly into place, and tighten both Brackets slightly with their Key-Screws.

Lights

Attach the two Rear Tubes **C-2** to the fixed Center Tube **C-1-b** by means of the four Fixed Tube-Clamps **C-2-a,** as shown in Figure **3.** Place the Adjustable Lamp Sockets **C-4-b** on the Side Tubes **C-3**, and then attach the Side Tubes to the Rear Tubes by means of the Adjustable Tube-Clamps **C-3-a.** The exact positions of the Lamps will be determined by the size of the Copy, as explained below. Then insert the Multiple Plugs **C-6** in the "Right Lamp" and "Left Lamp" Receptacles in the Base, attach the Lamp Cords **C-4-c** to the appropriate Plugs, and insert the Supply Cord **C-7** in the "Supply" Receptacle.

Camera

Attach the Camera **E,** Lens-down, to the Bracket **D** with the Key-Screw **E-1** (Figure **5**), making sure that the Stud on the face of the Bracket fits into the corresponding hole in the Camera Base to assure that the axis of the Lens will be vertical to the Base **A-1.**

Lens and Shutter

As packed in the Case, the Lens-and-Shutter Assembly is held in place on the Camera by two Locking Pins **S-4** screwed into the lensboard and held to the Camera Front by Shutter Clips **E-3-a.** Turn entire Assembly in a counter-clockwise direction, and remove it from the Camera. Remove the Locking Pin **S-4** nearest the Operating Lever **S-3**, and replace it with the Shutter Cylinder **S-2.** Then replace the Shutter on the Camera.

Magazine

Instructions for loading the Magazine are given below. It is attached to the Camera, with the Name-Plate facing the Operator, by means of the Slide-Lock **E-4-a** (Figure 6).

Pneumatic System

The Pneumatic System consists of the Foot Pedal, and a long and a short length of rubber tubing to carry the air compressed by it. Place the Foot Pedal **G-1** on the floor at the front of the work-table (Figure 1), and attach the long piece of tubing **G-2** to the Nipple **G-1-b** on the Foot Pedal and to the Magazine Cylinder Inlet Pipe **F-1-c**; then attach the short piece of Tubing **G-3** to the Magazine Cylinder Outlet Pipe **F-1-d** (Figure 4).

The Photorecord, except for loading the Magazine, connecting the Lighting System to the 110-Volt Power Supply, adjusting the positions of the Lamps and determining the Exposure, is now ready for operation.

PHOTORECORDING PROCEDURE

Double and Single-Frame Exposures

The first step in the Photorecord method of microfilming is to determine whether the material (called "Copy") may be copied on a *single* (25 x 19 mm) or *double* (25 x 33 mm) frame. This will be determined by the shape and size of the Copy.

A subject with a width no greater than approximately ¾ of its length, and a length no greater than 16", may be copied on the single-frame area of film. When the subject permits, maximum economy in film consumption may be obtained through the use of single-frame exposures.

The single-frame exposures are made with the aid of the Single-Frame Mask which may be placed in the picture aperture after removing the Magazine from the Camera and withdrawing the Slide. The Film-Advance Control **F-1-n** (Figure 4), must be moved from position "2" (the double-frame setting) to position "1" (the single-frame setting), while pressing on the Foot Pedal. This will then allow approximately one-half of the double-frame amount of film to be drawn into position for the next exposure. Before actually photographing, *be sure to advance the film at least two exposures* in order to avoid using the portion exposed to light during the change.

Focusing

The next step is to determine the proper position of the Camera to cover the Copy efficiently, and to focus the lens sharply on it.

Focusing the Photorecord by the projection method with the Focusing-Lamp House **H,** (Figures **8** and **9**) is similar to focusing a photographic enlarger.

In place of the negative in the enlarger, two coarse-grained lines scribed on the Ground-Glass of the Focusing Panel are focused on the Copy on the Base. Remove the Magazine from the camera and install the Focusing Panel, and attach the Lamp House to it by means of the Locking Pins **H-1-d** and Lamp-House Clips **E-6-d.** Set the Shutter at "T" and open it as described below. Plug the Lamp-House Cord into one of the Receptacles in the Base of the Photorecord and turn on the Switch **H-1-e,** permitting the beam of light to fall on the Copy placed on the Base (Figure **9**). Raise or lower the Camera and Lamp House until the beam of light covers the Copy. It is usually advisable to include a small amount of marginal area, to make sure that all of the Copy will be recorded even though it may shift slightly during the rapid handling. As soon as you have determined the proper position for the Camera, focus the Lens by turning the Focusing Knob **E-2-b,** (Figure **5**), until the lines scribed on the Ground Glass are brought into sharp definition on the Copy. Whenever practical, focus with the Diaphragm at the same aperture that will be used when photographing. Diaphragm openings of f/8, f/11 or f/16 will give very satisfactory results.

It is usually advisable to protect Copy material from strong side-lighting when focusing. The projection-focusing Lamp-House may be quickly removed from the Focusing Panel if it is desired to check the sharpness of the image on the Ground Glass by means of a powerful magnifying lens. For this operation the Copy must be well-illuminated.

Adjusting the Illumination

The third step is to position the lights properly to assure an even distribution of light on the Copy.

The Lighting System has the adjustability necessary to facilitate the even illumination of large as well as small areas, and to reduce the necessity of changing the position of the lights for varying sizes of Copy. See Figures **10-a** and **10-b.**

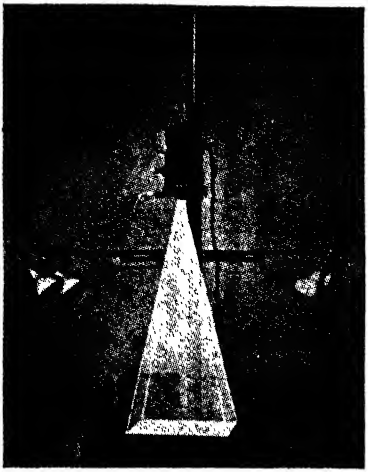


FIG. 9. Projection focusing.

In general, proper illumination of the material to be copied will be obtained, if **(1)** the dimensions **a** and **a¹** are approximately equal, with the Lamps placed symmetrically with respect to the Lens; and if **(2)** the Rear Tubes **b** (**C-2**) are far enough extended to permit the light to fall on the copy at an angle of approximately 45°.

For most purposes, the Lamp Sockets **C-4** should be about 26″ above the plane occupied by the Copy. For Copy from 6″ x 9″ to 10″ x 15″ in area, the lights should be placed as in Figure **10-a** with the Rear Tubes **C-2** almost meeting at the center of the upright Column. For Copy larger than 10″ x 15″, the Tubes should be fully extended as in Figure **10-b.** The position of the Camera on the Column will, of course, be at the point where critical definition is indicated by the focusing method described above. For Copy which requires the camera to be lower than 26″, the Lighting-Support Bracket **C-1** should be lowered with the Camera as necessary, or the Camera-Supporting Bracket **D** may be placed below the Lighting Support Bracket if it will not interfere with the cones of light from each of the four Lamps. In such an instance, the Rear Tubes should meet in the center.

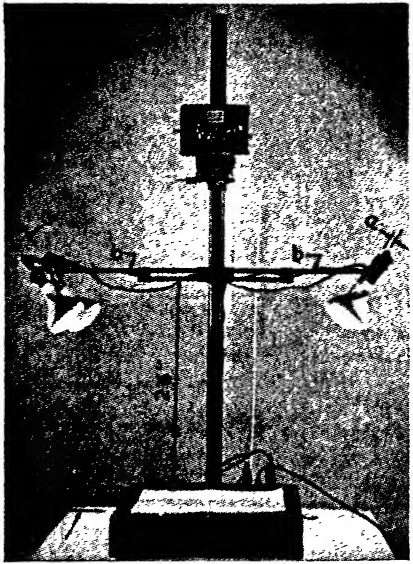


Fig. 10-a. Adjustment of the lights for average-size copy.

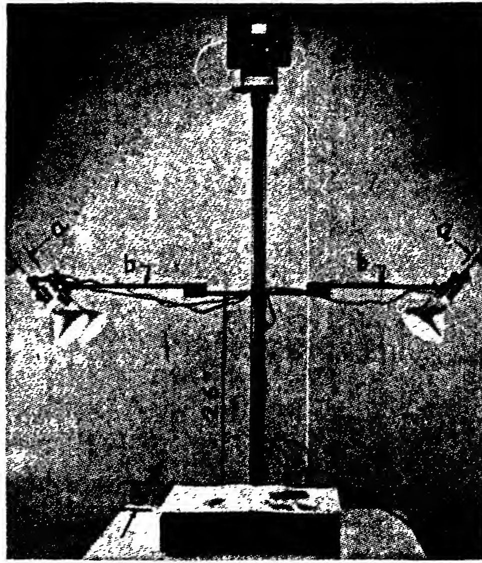


Fig. 10-b. Adjustment of the lights for large copy.

Loading the Magazine

Release the Slide-Lock **E-4-a**, disconnect the Hose **G-3**, and remove the Magazine from the camera. Unscrew the knurled Cover Knob **F-2-a** (Figure 3) in the center of the Magazine Cover **F-2** and lift off the Cover. Unless it is lifted evenly, the overlapping light-tight edges may bind slightly.

Film for the Graflex Photorecord is obtainable wound on No. 10 Eyemo spools, with a "leader" and "trailer" of opaque, non-sensitized film, so that they may be loaded into the magazine without "fogging" the film. It is recommended that film be purchased wound emulsion-in; but it may be had on special order wound on the spool with the emulsion, or sensitized surface, facing out. If the film is purchased in bulk (not wound on spools ready for daylight loading into the Photorecord Magazine), it must be rewound onto the No. 10 Eyemo spools for use in the Photorecord. This, of course, would be done only in a photographic darkroom. Bulk film should be wound on the Photorecord spools "emulsion-in," and so positioned on the spools that the film, as it unwinds in the Magazine, will turn the Supply Spool in a counter-clockwise direction.

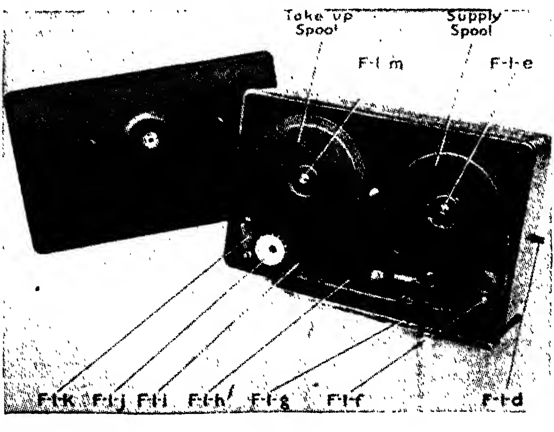
To load film wound "emulsion-in," place the full Spool of film on the Supply Spool Shaft **F-1-e**, with the squared opening in the lower flange of the spool *down* so that it fits over the squared section of the Shaft (Figure **11**). While positioning the spool the Floating Idler **F-1-f** must be held to the left of its normal position, so that the brake to which it is attached will be out of the way of the Spool as it is placed on its Shaft.

Place the film around the Floating Idler **F-1-f**, back of the Guide Stud **F-1-g**, under the Pressure Plate **F-1-h**, under the Stationary Idler **F-1-i**, between the Drive Sprocket **F-1-j** and Pressure Idler **F-1-k**, *making sure that the perforations in the film engage the teeth of the Sprocket*. Slip the end of the film into the slot of the Take-Up Spool, and place the Spool on the Take-Up Spool Shaft **F-1-m**, permitting the squared opening to engage with the squared section of the Shaft. Turn the Take-Up Spool clockwise until the film is taut, and check to be sure that the Film is not looped over the Brake at the top of the Supply Spool but moves freely between the two Spools. Then replace the Cover. If a daylight-loading spool with a leader of opaque film is being used, the film must then be advanced approximately forty double frames, either *pneumatically* by means of repeated pressures on the Foot Pedal, or *manually* by repeated movements of the Operating Stud **F-1-p** (Figure **4**).

To be sure that the film has advanced sufficiently before starting to make pictures, remove the Draw-Slide **F-1-q** and, if the film is not already visible, advance the mechanism until it does appear. Replace the Draw-Slide, advance the film two more frames, and the Magazine will then be ready for mounting on the Camera. Turn the Exposure-Counter Dial **F-1-a** to zero by means of the Counter-Setting Knob **F-1-b** on the front of the Magazine, and replace the Magazine on the Camera.

If the film is wound "emulsion-out" the same procedure should be followed, except that the film will turn the Supply Spool counter-clockwise as it unwinds, and will pass around the Floating Idler **F-1-f** as shown by the broken line.

FIG. 11. Loading the magazine.



Exposure and Development

The next step is to determine the exact exposure that will give a faithful reproduction of the tones and details of the original Copy. This depends on, and must be correlated with, the developing procedure.

Experience has shown that, for average copy material, an exposure of ½ second with the lens at f/11, on high-contrast positive film developed in D-11 for 10 minutes at 65° F., will secure satisfactory results. For Eastman Micro-File Film, a slightly longer exposure may be required. The above exposures are for *average paper surfaces and printed legends.* For copying highly-calendared glossy paper, faint typewritten carbon copies, or fine ink or pencil handwriting, slightly shorter exposures may be necessary. Test exposures are recommended wherever possible until the camera operator has become thoroughly familiar with the specific problems encountered in his microfilming operations. For example, a test-strip might include two exposures each at ¼, ½, and 1 second. After development, examination will show the best negatives, and the complete job can be microfilmed at the corresponding shutter setting. For larger material such as newspaper pages, county records, and engineering drawings, where there will be considerable volume of copying at one setting of the camera, time spent in making test exposures will be justified by the superior quality of the microfilm negatives. While strong contrast is desirable, make sure that development is not carried to the point at which fine detail is lost. The final application of a microfilm record will determine what contrast and density are best, so exposure and development should be adjusted, on the basis of tests, for each different type of work.

Test Exposures

It is important that test-exposure strips be developed in the same developer formula and under the exact conditions of time and temperature that will be used in processing the final microfilm negatives. Where the film is to be developed by a commercial finishing laboratory, consultation with the processing laboratory as to the developer formula available, will improve the quality of the final results.

Where a large amount of microfilming is contemplated, it is advisable to include with each roll a separate "pilot strip" of about one dozen exposures typical of the work included on each roll. This "pilot strip" may first be developed by the film-processing laboratory to determine what modification, if any, should be made in developing the larger roll of film to insure the best possible results.

Setting the Shutter

Having estimated the approximate exposure range to be tested, the Shutter and Lens are set as follows for making test exposures:

The shutter speed is set by moving the Shutter-Speed Lever **S-1** (Figure 5) until it points to the desired marking on the Speed Scale. Speeds intermediate to those marked on the Scale may be obtained, but an intermediate position may not necessarily indicate an exposure of proportionate duration. Such intermediate settings should be considered as purely relative, and useful only for resetting the shutter to produce, at a later time, an exposure time previously found to be satisfactory.

Time exposures may be made by setting the Lever **S-1** opposite the letter "T" on the shutter. At this setting air pressure through Cylinder **S-2**, or manual pressure on Release Lever **S-3**, will cause the Shutter to open and remain open. The Shutter may be closed, after the desired interval, *only by manual operation of the Lever* **S-3.**

Bulb exposures may be made by placing the Lever **S-1** opposite the letter "B" on the Shutter. At this setting the Shutter will remain open only while pressure is applied through Cylinder **S-2** or on Lever **S-3**. Normally, Time exposures will be used when shutter speeds longer than one or two seconds are required.

Setting the Diaphragm

The Lens Aperture settings are made in a manner similar to the setting of the Shutter Speeds, by moving the Diaphragm Lever **S-7** at the bottom of the Shutter until it points to the f/ number indicating the desired aperture.

Making Exposures

Draw out the Slide **F-1-q,** so that the film in the Magazine will be exposed when the Shutter is opened.

Step firmly on the Foot-Pedal **G-1,** holding it down until the second click (the closing of the Shutter) is heard and the picture is taken. When the pedal is depressed, air presssure is forced through the rubber tubing to the Magazine Cylinder, which causes the film to be advanced, and then opens a valve to permit air to pass to the Shutter Cylinder, thereby operating the Shutter.

The Copy material may now be changed, and repeated pressures upon the Foot-Pedal will advance the film and make the subsequent exposures in sequence.

SUGGESTIONS FOR BEST RESULTS

Semi-Permanent Installation

It is recommended that, whenever possible, the Photorecord be used as a semi-permanent installation. This may be done very easily with the use of two Brackets available for the purpose. These Brackets may be securely fastened to a wall or other solid support, to hold the Column of the Photorecord rigidly at its extremities.

Handling Copy

When a large amount of work involving many different sizes of material is to be done, and time is of importance, it is suggested that the material to be copied be sorted into three or four different sizes, each size requiring one position of the Camera and Lights. This will eliminate much time spent in re-adjusting the camera, and re-focusing the lens. A reduction of approximately 14 to 1 will include the majority of books, correspondence, periodicals, etc.

To insure that the material lies flat when being copied, a piece of plate glass may be used to hold down the pages of the book, or other subject matter. Check the positions of the lamps to avoid direct reflections into the lens.

Illumination

Good illumination of the material to be copied is very important. Be sure that the lamps are set in accordance with the instructions given above, and are centered with respect to the Copy.

Film

Important--**Insist on acetate-base safety film.** This long-lasting, non-inflammable film may be used and stored with complete safety.

When loading the magazine with the daylight-loading spools of film, which have a leader of approximately 5 feet of non-sensitized film, care must be taken to advance the film after loading until the sensitized portion may be seen through the picture aperture with the Slide removed. After completing the exposure of the full 800 double frames, or 1600 single frames, be sure to continue advancing the film until the entire strip of 6 feet (48 exposures) of non-sensitized trailer film has passed the aperture, and is thus wound around the exposed film. This will protect the film so that the magazine can be unloaded in daylight.

Tests and Processing

It is very important to make complete test exposures of all of the different types of material to be photographed. These test exposures should be very carefully developed in order to determine the proper combination of diaphragm opening and shutter speed required to obtain the best results. When developing the rest of the film, be sure that it is developed in **exactly** the same developer, at **exactly** the same temperature, and for **exactly** the same time that the most satisfactory test exposures were developed. Only in this way will the finished roll of film have the same quality as the approved test.

Different types of negatives are required for different uses. Whenever possible, inspect the developed test-strip under the conditions under which the finished microfilm will be used. In general it will be found that a thin negative is desirable for projection printing, and a denser negative when it is to be used principally in a microfilm reader. Basic experiments along these lines will establish the best type of negative for your use, which will facilitate more prompt and accurate evaluation of future test-strips.

Processing methods depend primarily upon the type of film being used and the amount to be processed. It may be that you can handle small sections of film yourself, or use special 35 mm developing equipment of one type or another. If not, the work can be done by commercial processing laboratories, and the Graflex Service Department will be glad to suggest outside organizations capable of doing this work for you.

In processing we advise following the instructions of the manufacturer of the film regarding developer formulae, temperature, and developing time, unless your experiments prove definitely that other procedures are preferable for the type of negative required in your work.

Color films, such as Kodachrome, are processed only by their manufacturer, and should be returned to him in accordance with the instructions accompanying the film.

ACCESSORIES

Book Cradle

This accessory serves to hold books being microfilmed, keeping the pages flat. It accommodates bound volumes as large as 19½ x 26 inches when opened. Adjustable, spring-supported platens force the book up against a glass plate, keeping the pages in a plane and at a constant distance from the Lens. A felt-covered Copy Board for flat material is included with the Book Cradle.

The Book Cradle may be placed directly on the Base of the Photorecord, or on the work table if the Photorecord is permanently or semi-permanently installed. In order to locate the Lens directly over the center of the Book Cradle when it is on the Photorecord Base, an accessory Extension Camera-Bracket is required; this is not necessary if the equipment is permanently or semi-permanently installed in such a way that the bottom of the Column does not interfere with the Cradle. In cases where very large Copy or the Book Cradle is involved, and the Extension Bracket is not available, the Base may be placed on the table in such a way as to permit turning the Camera 180° on the Column so that it projects over the edge of the table, and the Copy may be placed on a stool or on the floor.

To use the Book Cradle, if books are to be microfilmed, remove the flat Copy Board and place the book on the Platen; lower and fasten the glass plate, and then turn the Handle at the right side until the Platens are adjusted to hold the pages as flat as possible without damaging the binding. The entire book may be copied in this position—the glass plate being raised to permit turning the pages, and the pages being smoothed through the U-shaped cutouts in the front as the plate is brought down.

2¼ x 3¼ Graflex Film-Holding Accessories

When negatives somewhat larger than 25 x 33 mm are desirable, 2¼ x 3¼-inch (6 x 9 cm) film or plates may be used in Graflex Sheet-Film Holders, Graflex Plate Holders, Graflex Film-Pack Adapters and Graflex Sheet-Film Magazines in the 2¼ x 3¼ size. Although the image will not be uniformly sharp over the entire area of the negative, because of the short focal length of the Lens in relation to the dimensions of the film, such negatives might be useful for such work as personnel identification, making lantern slides, and for recording geological, philatelic, numismatic, and similar small specimens. Use the standard 2¼ x 3¼ Graflex Focusing Panel when focusing the lens for use with these accessories.

The Motor Compressor

When a large quantity of microfilming is to be done, the Motor Compressor (Figure 12) will be found a great help in speeding up the work. It replaces the Foot Pedal, and maintains the necessary 25-30 lb. air pressure. A touch of the foot, knee or hand on the Valve is all that is required to make a picture, leaving the operator free to sit or stand, as he wishes.

To hook up the air lines with the Motor Compressor, one end of the Short Tube is plugged into the nipple at the top of the Compressor and the other

end into the upper opening in the Supply Valve; the long tubing is then connected to the other opening in the Supply Valve and to the Magazine Inlet Pipe **F-1-c.**

The "bleeder valve," or pressure-regulator, on the side of the Compressor Dome, is set at the factory to maintain the pressure in the neighborhood of 25 to 30 pounds. If necessary, the pressure can be adjusted by loosening the set-nut on the bleeder valve and adjusting it as required. **It should be adjusted to give no more than the minimum pressure necessary to the positive movement of the film and operation of the Shutter,** since excessive air pressure may subject the moving parts to unnecessary wear and cause undesirable vibration of the equipment.

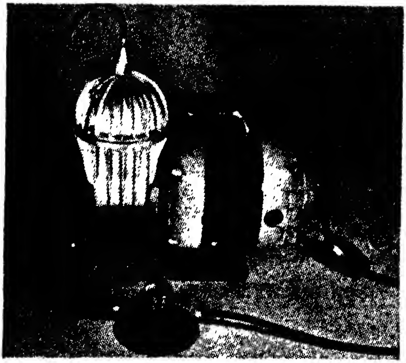


FIG. 12. The Motor Compressor.

Because of the high operating speed permitted by the Motor Compressor, an exposure must not be made until the operator is certain that the previous cycle is complete. If the Compressor tends to cause undesirable noise or vibrations it may be cushioned on a rubber pad, or removed from the Camera and a longer Tube used between it and the Supply Valve.

Air Lines and Pressure Cylinders

When factory air-lines or cylinders of compressed air are available, they may be used with the Motor-Compressor Valve and Tubing—provided a pressure regulator is added to reduce the pressure to the neighborhood of 25 to 30 pounds.

Filters

Originals are often stained, yellowed with age, or offer low color-contrast. In such cases, filters with panchromatic film are valuable in increasing contrast to assure a distinct image. It is helpful to remember that a filter will make areas having a color the same as, or similar to, its own, appear darker in the negative, and lighter in a print, than they otherwise would. Black printing or writing on a white sheet stained yellow, will photograph more distinctly with a yellow filter than without one, because the yellow filter will make the yellow stain take on the same value as the white paper.

Yellow filters such as the Wratten K1 and K2, or orange like the G, are especially suitable for age-yellowed books and newspapers. Purple material from liquid duplicators ("Ditto," for instance) is given more contrast by green filters like the Wratten X1 and X2. Blueprints are given great contrast and legibility by means of the Wratten A or F, or other red, filters. It should be borne in mind that panchromatic emulsions are required for use with filters, and that positive film is usually not panchromatic and hence cannot be used with them.

Since filters absorb some of the light reaching them from the Copy, their use requires an increase in exposure. This increase for any one filter (known as the "filter factor") varies with different types of film; filter factors are usually given in the literature supplied with film, or may be secured from the manufacturer of the film and/or filter.

A factor of 2 requires that the exposure should be doubled. That is achieved in either of two ways: **1** by slowing down the Shutter (from 1/4 to 1/2 second, for example), or **2** by opening up the diaphragm one stop (as from f/16 to f/11). A factor of 1.5 requires a 50% increase in exposure, which can be secured by opening the diaphragm 1/2-stop. Adjustments for other factors are made in a similar way.

Full information on filters and their use can be secured from Graflex or from the manufacturers of the filters.

Processing Equipment

For developing long rolls of Photorecord film, the Stineman or similar equipment may be used. Stineman Developing Outfits consist of three nesting tanks and a spiral reel onto which the film is wound by means of the jig provided. The tanks are filled respectively with developer, water, and hypo, and the loaded reel immersed successively in the tanks for processing. The film is most conveniently dried on drying racks. Reels alone may be purchased if suitable tanks are already available.

Film-Storage Spools and Boxes

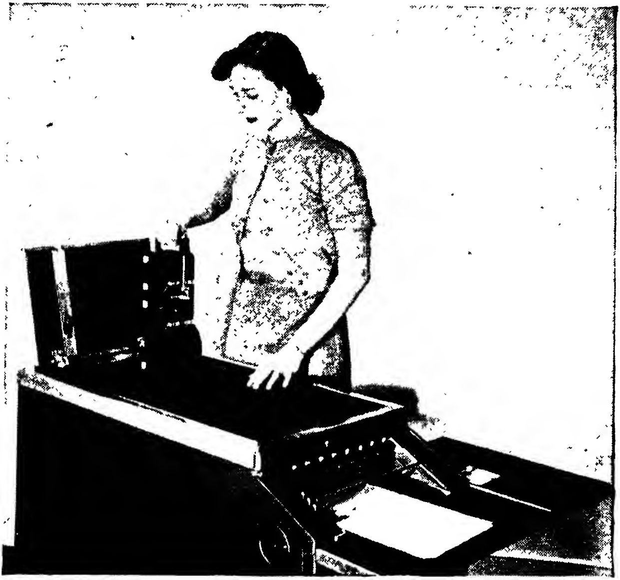
Processed film may be stored on black metal spools, which are also convenient for use in microfilm readers, or in cardboard boxes of proper size. Both items are available from Graflex.

Miscellaneous Accessories

For permanent or semi-permanent installation, special Brackets, Clamps and Column Sections may be required. Write our Service Department in detail, outlining your problem and facilities completely so that we may advise you properly as to what equipment can be supplied.

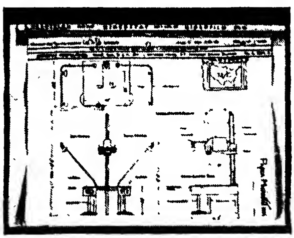
Remington Rand's model 5 Film-a-record microphotographic document machine presents several excellent features. Like the Recordak this 16 mm camera uses just the amount of film required to copy each document—plus a fraction for spacing. Film-a-record exposes two rolls of film at one time when duplicate records are required. The film is contained in a camera readily removed from this compact office machine. Office records and copy up to 11½ inches in width by any length can be handled. Automatic devices eliminate fogging, signal when the film supply is exhausted, prevent more than one sheet of paper being fed at a time, indicate when lamps within the camera are burnt out.

Equipment somewhat like the foregoing is manufactured and used by Holbrook Microfilm Service, Pathe Manufacturing Company, Graphic Microfilm Service, and one or two smaller commercial concerns. The Pathe camera embodies office desk design and is called the Pathe Automatic Film Recorder. Many of the Microstat All-Purpose Camera-Projectors have been redesigned for special uses and include such modifications as book cradles, non-perforate film transports, 16 mm film advancing mechanisms, and daylight projection features.

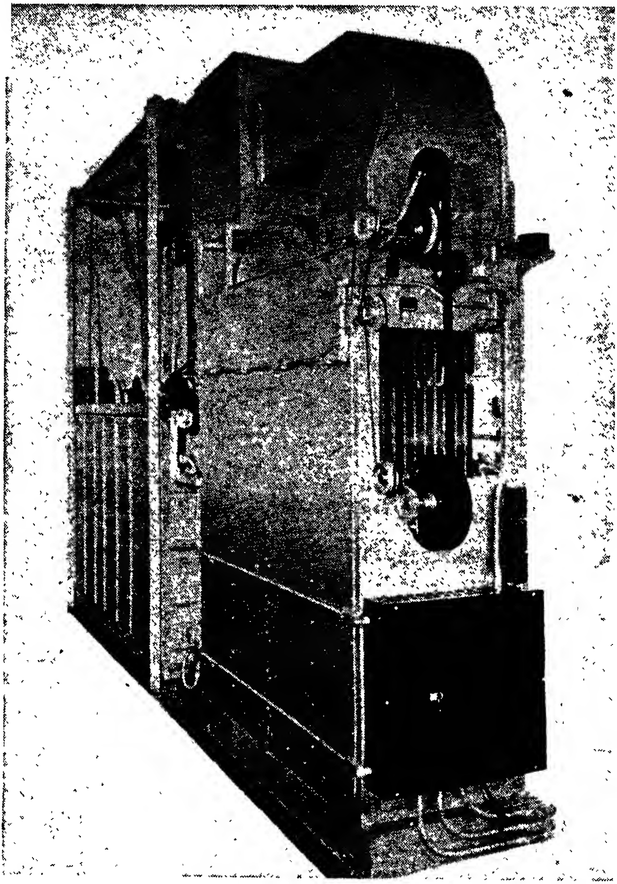


Remington Rand

Loading double lens and film magazine into Film-A-Record 16mm office camera.



Microfilm-by-Microstat non-perforate positive.



Fonda Machinery Company

Automatic film processor.

Chapter V

PROCESSING MICROFILM

Via registered mail, via insured express, via armored car, via bonded messenger, exposed microfilm rolls arrive at the laboratory for darkroom development. Processing microfilm involves quantitative and qualitative chemical control, time and temperature control, trained fingers working in darkness. No mere hypo-slopping tyro is allowed to process microfilm. This valuable product can only be entrusted to persons who are highly skilled, extremely exact and manually dextrous.

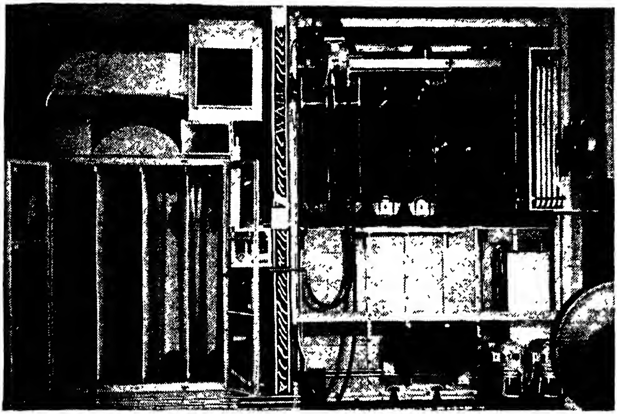
Men and women who have qualified as microfilm processors may, depending on the individual plant, be assigned to produce on either manually operated processing systems, such as the Stineman, rack and tank, or on automatic continuous developing machines. In any case, considerable skill is required to produce evenly developed, completely fixed and hardened, thoroughly washed, properly dried, scratch- and scum-free negative and positive microfilm.

Much of a processor's time is spent in almost

total darkness. Here a feeble green light casts a pale glow-worm gleam on the face of the time clock and thermostat control. Reel, valve, and rinse basin outlines are barely discernible. The precious microfilm is moved from loading platform to developer, to "hypo" hardener, to wash. Finally, after some carefully clocked minutes have elapsed, the lights are turned on and the film is moved into a dust-free drying room. After drying, the film is ready for inspection, the processor is ready for another batch awaiting processing, or it may be time to check solutions, mix chemicals, prepare the reagents, or clean up the apparatus. Records are also kept by the processor showing production output, listing H. & D. density readings, and the contents of each batch of microfilm processed.

Processors are trained, not born. Hence one finds a large microfilm laboratory hiring apprentice processors, promoting the trainees to the successive posts of assistant processor, processor, chief processor.

Men and women of patient temperament, possessed of a critical and analytical faculty, will succeed as microfilm inspectors. Specifically, they must be able to read extremely fine lines of typed or drawn matter for long sustained periods, to do



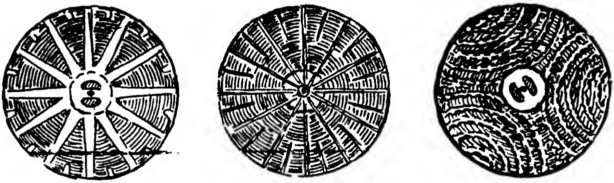
Fonda Machinery Company

Automatic microfilm processing machine opened for cleaning and inspection.

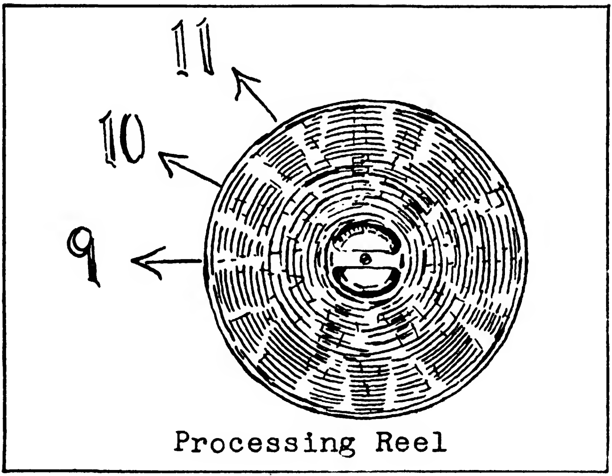
this without developing eye, head, or back aches. They must also be able to resolve optically minute differences in individual microfilm frames, to do this with the unaided eye, to check the overall results by plotting gamma curves, calculating resolution, reading a sensitometric scale, aiding their visual inspection by means of a low power magnifier or a microscope.

Record keeping is of necessity an essential part of microfilm inspection, as all corrections and billings are based on these records. The efficient and thorough inspection of the finished product is of prime importance to both the customer and the auditor, the camera operator and the production manager. On the findings of the inspector all corrections of mechanical or human error are ordered. These are called "retakes."

Inspectors, like processors or operators, are usually classified by pay grades and promoted on the basis of seniority and ability. Men and women are equally successful in this work provided they have the necessary prerequisities of stable temperament, exceptionally good vision, critical sense, and general analytical ability. Some scientific training will aid inspectors in the effective formulation of reports and graphs, the conduct of critical tests, the orderly presentation of the accumulated evidence gathered in their day-to-day work.



STINEMAN SILVER WATSON



Reel with Left-Hand
Positions indicated
as "clock" positions.

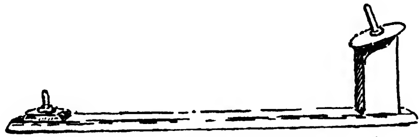
Microstat Corporation

The processing and inspection techniques that follow are used by the Microstat Corporation and its licensees.

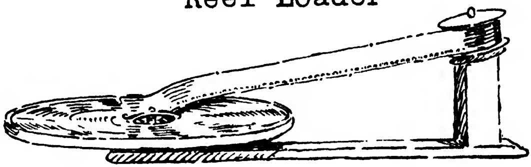
Stineman, Watson, and silver reels are loaded as follows:

1. Place reel on the reel pin of the loading rack.
2. Place roll of exposed film on the diagonal spool pin.
3. Crimp and double fold the lead end of the film to attach to the innermost spiral of reel.
4. Keep the sprocket edge of the film down and the emulsion side out.
5. Revolve the reel with the right hand in counter-clockwise direction, holding the left hand lightly on the edges of the spinning film in the reel in a "nine o'clock" position.
6. As the reel fills, the left hand is moved upward slowly to a "ten o'clock" position.
7. When the reel is filled, the left hand should be in the "eleven o'clock" position. Double fold the trailing end of the film to hold it in the reel. Use a paper clip if necessary.

Care of Laboratory and Equipment. Housekeeping is most important.



Reel Loader



Loading the Reel

The Microfilm Corporation

Certain rules must be kept in mind:

1. Fifteen minutes before the end of your "trick," clean your laboratory and drying room.
2. Your working quarters must be kept clean at all times, free of dust, scraps, developer, or hypo slop.
3. Exposed film must be securely taped and labeled.
4. Empty containers, spools, and waste wrappings must be disposed of.
5. Floors, walls, washing tanks, and utensils must be scrubbed, rinsed, and mopped off as often as necessary.
6. Clean the sponge dish daily.
7. Remove all stray ends of film from the drying racks and the floor of the drying room after each shift.
8. Clean reels after film is washed, rinsed, and dried.
9. Scour wet Stineman reels with silicon carbide abrasive paper and wash them thoroughly. (NEVER USE ABRASIVES ON SILVER OR SILVER-PLATED REELS.)
10. Dry reels carefully after every batch of film has been processed, being careful to avoid bending them or doing other damage.

General Instructions. Conditions must be carefully controlled during the processing of microfilm. Rules to be observed are as follows:

1. Film must be loaded on reels in absolute darkness except for the green safelight facing the interval timers.
2. Caution must be taken that all doors of the processing room are securely bolted from the inside.
3. All solutions must be at the correct working temperature.
4. Develop all negatives and positives at indicated time and temperature for the film and the solutions used.
5. Do not develop more than six loaded reels per pan of fresh developer.
6. Change hypo-hardener solution after every 12 rolls of film per pan.
7. Special caution: Never handle film except by the edges and never permit fingers to come in contact with the emulsion side of the film.
8. Use cool, dry reels.
9. Never lift reel except by the center handle bar or finger grips.

Processing Sequence:

1. In developer.
2. In hardener-fixer (hypo solution).
3. In running water.
4. In final rinse for five minutes.

Steps in Processing:

1. Place reel in processing tray which contains developer and set clocks.
2. Agitate at once by revolving reels counter-clockwise ten full turns.
3. After first five minutes, take up slack. Agitate again for ten full turns.
4. Slack is taken up by placing the flattened palms on top edge of film and gently moving it in a clockwise direction. Lift the trailing end and pull it forward in this same right-hand direction. Reinsert outer end of film between the turn of the reel.
5. After developing, place reel in the fixing tray which contains hardener-fixer (hypo bath).
6. After the hypo bath, place reel in the washing tray where water at 65° F. washes through it for 30 minutes.
7. Free the two ends of the film from the reel.

The Microfilm Corporation

Processing microfilm.

8. Turn the reel upside down and shake the film into the unloading pan.
9. Coil the film by rotating the index finger in the center of the free roll resting in the unloading pan.
10. Place this coil on the drying drum.

Three types of processing reels are in general use: the Stineman, the silver, the Watson. All are fragile, all must be handled with care.

Processing Instructions:

1. Stineman reels require the processor to take up film slack after the first five minutes of development.
2. Silver reels require the processor to take up film slack after the first five minutes of development.
3. Watson reels do not require any taking up of slack except on the three outer turns at the end of the first five minutes.

Cleaning Instructions:

1. Stineman reels require scouring with silicon carbide paper every time they are used.
2. Silver reels do not appear to require any cleaning. Do not attempt to scour them or clean them.
3. Watson reels do not appear to require any cleaning. Do not attempt to scour them or clean them. The silver plating is thin and easily removed. Tarnish may appear but will not affect the film.

Dry microfilm as directed:

1. After placing the coil removed from the unloading tray on the drying drum holder,

The Microfilm Corporation

Drying microfilm.

thumb-tack the free outer end of the film, emulsion side out, to the right hand side of the drying drum.

2. Sponge the film thoroughly with viscose sponges that have soaked in a rinse solution. Keep sponges and sponge dish clean at all times.

3. Wind the film on the drum while using sponge as follows:
   (a) Switch on drying drum motor or rotate drum by hand.
   (b) Do not switch on reflectorflood drying bulbs until film is on the drum and anchored.
   (c) Caution: Never reverse this order.
4. After two minutes of drying, turn off the lights, stop the motor or hand rotation and loosen film.
5. Rotate again or turn on the motor and lights for three more minutes.
6. After these five full minutes of lamp drying, turn off the lights and rotate the drum for another two minutes.
7. Stop the motor or hand rotation and rewind the film if it is perfectly dry; if not, repeat the five-minute run under the lamps and the two-minute run with lights off. Rewind.
8. Deliver processed roll to the inspector.
9. Avoid finger marking the processed roll.
10. Keep all equipment clean at all times. Cleanliness insures good processing.

A hypo elimination test should be run by all processors at least once every shift. This test is essential to quality microfilming and it is to the best general interest that it be performed carefully, consistently, and correctly.

Apparatus:

1. Select a permanent location for the hypo test apparatus. A small shelf hung at forty-eight inches from the floor and oblique to the prevailing room light is ideal. On the shelf keep the test tube rack, a small pair of scissors, a pencil, a note pad, a small clock and a bottle of Hypo Elimination Test Solution. Provide a pail under the shelf to receive film clippings and used test solution.
2. The hypo test tube rack contains six test tubes and supports a black background. The left end tube space on the rack is marked "CS" (Control Standard). The remaining five tube spaces are numbered one to five and designate each roll.

Directions:

1. Fill each of the six test tubes with hypo test solution level to the white line on the black background.

2. Clip a full microfilm frame from the inspector's test strip at the head of each roll processed. Drop the frames into the numbered tubes and note on the pad of paper which tube corresponds with which roll and the time of immersion.
3. At the end of ten minutes observe the appearance of each of the five numbered tubes comparing their liquid with that in the left end tube marked "CS."
4. If hypo has been completely eliminated the liquid in all six tubes will look the same when viewed against the black background. Disregard the silver image on the film clippings. The image will bleach white because of chemical action.
5. If hypo has not been completely eliminated the liquid in the numbered tubes will appear milky when compared to the control standard tube (CS).
6. If the tubes are clear mark the roll O.K., if the tubes are milky mark the roll or respective rolls NG. and immediately have the film rewashed and retested; be on the lookout for inadequate washing resulting from faulty processing.

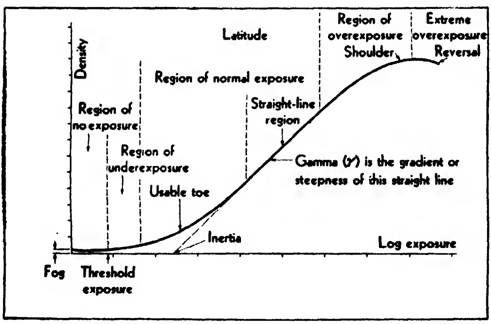
There must be no deviation whatsoever from standard inspection procedures. Each of the following 15 points is vitally important:

1. Unroll about four feet of the processed film; examine by reflected light for water spots, stains, reel or finger nail scratches.
2. Attach the roll to the editing desk and cut off the H. & D. strip and the inspector's strip. Staple these strips together and file in a can labelled "Inspector's Strips for—(Name of Contract serviced.") Be sure, before filing, that you have taken the gamma reading and recorded it and noted all information contained on the inspector's strip. Gamma is determined through density readings taken from an H. & D. density scale strip. The 11th square on this strip is notched. The next square, lighter in density, is the 10th square. Subtract the density of the 8th square from that of the 10th square and divided the difference by 0.3. The result, Gamma, should not be less than 3.7, more than 4.1. Expressed as a formula

$$\text{Gamma} = \frac{\begin{array}{c}\text{Density 10th H\&D square}\\ \text{minus density 8th H\&D square}\end{array}}{0.3}$$

The Microfilm Corporation

Inspecting microfilm.



General Electric

Characteristic negative curve.

Or gamma tests can be greatly simplified and H. & D. strips eliminated if operators will follow the procedure outlined:

After shooting the repeat test chart and title block at the end of a roll of film, expose one frame of back-ground at 250 foot candles (measure by incident meter) and one frame at 125 foot candles.

Processors can therefore eliminate the use of H. & D. sensitometric strips. This will make processing easier and more economical.

Inspectors then measure gamma by taking the density of the dense frame (250 foot candles), subtracting the density of the less dense frame (125 foot candles) dividing the difference by three-tenths (0.3). The result equals gamma.

3. Read and record the resolution figures.
4. Check data on first and last frames against data you have recorded on the roll report from the inspector's strip.
5. Wind film to first frame and set film frame counter at zero. Be sure sprocket teeth are engaged in sprocket holes or that rubber friction roller is fully engaged.

6. Check density at beginning and end of roll and two or three times in middle of roll if density or copy seems to have changed.
7. Deduct all blanks from machine count but do not punch them.
8. Note each retake on the roll report correctly and check retake instructions to operators in order to insure correct transcription of retake notes.
9. Watch general appearance of the microfilm and report anything unusual to the chief inspector. Note positioning of copy, overlapping frame lines, fogged or hypo-stained sections, light streaks, scratches made by the camera or the processor, and other possible defects. In drawings taken in sections, the density of individual frames may vary. Dirty, yellow copy will show clear lines against a dense background. Even though the background density is excessive, if the fine lines are clear and not grayed, pass the film.
10. At the end of roll, note number of frames taken by gross machine count. Deduct duplicates, blanks, and retakes, and record net count. Initial the count; your initials mean that you have inspected the roll reported.

11. Check to see that roll identification chart at end of roll is correct.
12. Remove test strip at end of roll and record resolution figure. Staple this to the inspector's and H. & D. strips.
13. Check typed container labels against your roll report. Accuracy is of paramount importance here.
14. First and last rolls of every contract should be inspected as soon as possible.
15. Last roll results, including retakes, should be transmitted by the fastest possible means to the camera operator in order to avoid idle time and costly delays.

Microfilm negatives processed in PD-5 will yield a gamma as high as 4.9 and a background density between 0.9 and 2.0.

The best average overall contrast is found in negatives having a background reading of about 1.6. It is important in all cases to make sure that all lines and figures are clear, transparent, not grayed or fogged, not grayed along the edges.

Remembering that gamma expresses the relationship between exposure and development and that the majority of work is "process" copying, it is clear that the higher the gamma the better the contrast. A high contrast negative with a dense

Appearance or Description of Negative Defect	*Probable Cause*	*Remedy, if Correction is Possible*
Negative is clear, showing no trace of image.	Lack of exposure through inoperative shutter, failure to remove film pack "O" tab, or remove lens cap or film-holder slide. Use of totally exhausted developer, improper developer, or fixing bath instead of developer.	None.
Spots or markings irregular in shape and lower in density than nearby areas, sometimes exhibiting darker edge and clearer center.	Drops of water remaining on surface of film hung up to dry, resulting in uneven drying of the negative. Also waterdrops splashed on partly dried negatives.	Water spots can be prevented by carefully wiping washed negatives with damp chamois before drying. In some cases, marks can be minimized by rewashing and drying.
Heavy deposits of silver near edges of film, sometimes extending into picture area and, on roll film, revealing texture of protective paper and film-winding numbers.	Light-fog resulting from unsafe film holders or light striking in between spool flanges and protective paper of roll film.	Careful inspection of equipment, loading and unloading of roll film in subdued light, proper protection of roll film after removal from camera.
Scratches varying from slight surface marks to deep cuts which completely penetrate emulsion layer.	Excessive or rough handling of films during devolopment process, some cases also due to abrasion marks caused by rough handling of dry film in loading or unloading holders.	Careful handling of film throughout all stages of development.
Network of lines over surface of negative giving emulsion a wrinkled or leathery appearance (reticulation).	Excessive or exceedingly abrupt changes of temperature during development of film.	Maintain developer, short-stop, fixing solution and washing bath as closely as possible to optimum temperature of 68° F.
Small, circular markings (called blisters) which pit the surface of the emulsion leaving rough, crater-like depressions.	Formation of carbon dioxide gas resulting from insufficient agitation in short-stop or fixer, or reaction between strong developer carried over on film with excess acid in fixing bath.	Agitation of film in short-stop and fixing bath will usually prevent formation of blisters. A sure prevention can be had by use of developer using sodium metaborate or borax as the alkali.

Appearance or Description of Negative Defect	*Probable Cause*	*Remedy, if Correction is Possible*
Negative is thin and lacks detail, especially in thinner parts of negative.	Under-exposure.	Intensification may help. In future use larger lens openings or longer exposures under similar light conditions.
Negative is generally dense and requires extremely long printing time.	Over-exposure.	Reduction may help. In future use smaller lens openings or shorter exposures on such pictures.
Negative shows sufficient detail but is generally thin and gives "flat" prints.	Under-development. (Development too short or at too low a temperature)	Make prints on Medium Hard or Extra Hard Convira. In future be sure films are developed in fresh solution for recommended time at 68° F.
Negative image is clear in thinner parts but dense and "blocked-up" in highlights of subject.	Over-development. (Development too long or at too high a temperature).	Make prints on Soft or Extra Soft Convira. In future decrease time of development and develop at 68° F. Reduction of negatives may help.
Negative gives "flat" prints, is generally dense and has margins that are gray—not clear.	Light-fog from unsafe developing lamp.	Making prints on Extra Hard Convira may help. Test your safe-light. Use Agfa No. A7 or other deep-red for Plenachrome, total darkness for panchromatic films.
Negatives are obscured by milky, opalescent color, more noticeable on shiny side, possibly appearing in patches.	Incomplete fixation.	Replace negative in fixing bath, then wash and dry. Complete removal may be impossible if film has been exposed to bright light. Use fresh solution when fixer becomes exhausted.
Negatives show faint red or blue coloration uneven or in patches.	Anti-halo color incompletely removed or recurring.	Place washed negatives in developing solution or in 5% solution of Sodium Sulphite for ten minutes, wash and dry.
Negative shows brown stains or streaks.	Insufficient agitation in fixing bath has allowed waste products of developer to stain film.	No remedy. In future agitate films when placed in fixing bath or use acid short-stop after development.
Small round spots that are clear or show less density than remainder of negative.	"Air-bells." Bubbles of air have adhered to film preventing development.	Wet film thoroughly before development or, if sheet film, make sure films are placed in developer with sliding motion and agitated.

Ansco

black background showing clear transparent lines and figures is therefore the aim when microfilming engineering records and where similar line copying document work is involved. This aim is especially important in considering positive film for use in projectors and reading machines. Only high-contrast positive film is acceptable if the eye-strain of persons using microfilm is to be eliminated. Good contrasty positives result from good contrasty negatives and have the appearance of lantern slides when they are projected.

High contrast microfilm negatives are assured through the use of a high contrast developer, and two other factors. These include correct exposure meter design and control such as developed and perfected by The Microfilm Corporation in Ohio; the use of neutral gray background paper—also submitted and tested by the technicians of that organization and found superior to glazed white paper when microfilming pencil-on-vellum.

Resolution is determined by:

1. Deriving Lines Per Millimeter. Resolution tests derive the lines per millimeter of a given frame of test film. This frame, which pictures five resolution charts (in the center and the four corners) is placed under a 40-

power microscope. Each of the 5 Bureau of Standards resolution charts is studied separately.

(a) The smallest unit on the resolution chart where parallel lines can be counted with certainty is determined.

(b) The number attached to this unit represents the lines per millimeter at this particular point on the full scale resolution chart.

(c) When this number is multiplied by the number of times the chart has been reduced in making the microfilm picture, we have the lines per millimeter which can be read on the frame of film.

(d) The number of times the chart has been reduced is called the reduction ratio.

(e) The average resolution of the charts must be not less than 65 l/mm.

2. The Reduction Ratio. This is most easily pictured by imagining the number of times the diameter (length) of a frame of film can fit into the diameter of the copy microfilmed.

Calculate the reduction ratio as follows:

(a) The length of the mask in the camera box, e.g., Microstat J-7 B (1-7/16″) is divided into the length of the projected image on the background when the camera is at the height for taking the frame being studied.

(b) Formula for Lines per Millimeter: Number of the smallest discernible resolution chart units multiplied by reduction ratio equals lines per millimeter.

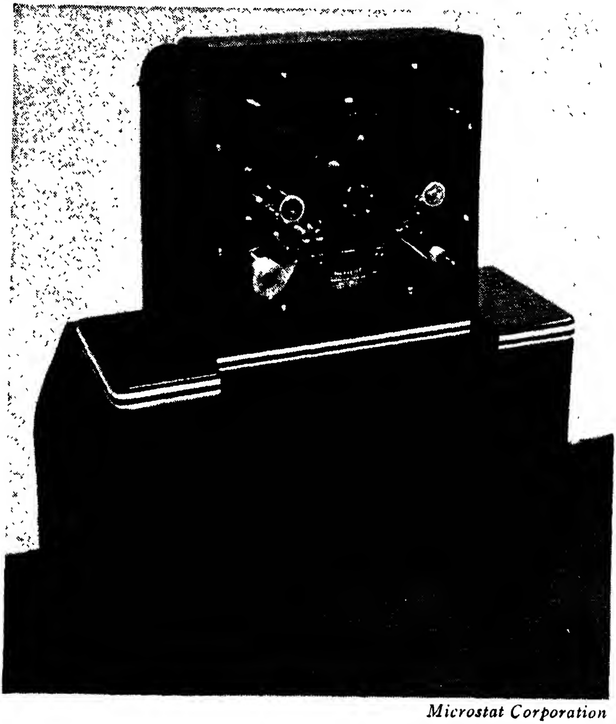
The Microfilm Corporation

Checking resolution.

RESOLUTION READING (L/mm) TABLE

	Coverage →	A=	B=	C=	D=
	Multiplying-No. on Millimetric Scale	9	13.2	18.5	26.3
Resolution No. →	2.8 →	25	37	52	74
Example: 2.8—Res. No. x 9—Cov. 25.2=25 (Taken to nearest whole no.)	3.15	28	42	58	83
	3.5	32	46	65	92
	4.0	36	53	74	105
	4.5	41	59	83	118
BEST READING from 65 L/mm up	5.0	45	66	93	132
	5.6	50	74	104	147
	6.3	57	83	117	166
	7.1	64	94	131	187
	7.9	71	104	146	208
	8.9	80	117	168	234
	10	90	132	185	263

The Microfilm Corporation



Microstat Corporation

Microfilm Printer by Microstat, Type P-3, for 16 and 35mm film, perforate or non-perforate, prints 100 feet in 5 minutes.

CHAPTER VI

PRINTING MICROFILM

POSITIVE projection film prints, "positives" for short, are made by contact printing negatives on raw positive film stock, and developing the positives. White lines and black backgrounds on the negative appear black on white in the finished positive. Projected onto a screen the positive film appears greatly enlarged and each single exposure frame is like a separate movie frame or a projected lantern slide. Positive printing is usually done by a microfilm technician operating a continuous strip printer or photo-electrically controlled step printer. Development may proceed in high contrast developers or by ammonia vapor acting on diazo coated Ozalid film. Such Ozalid film prints, however, are "positive." A negative yields a duplicate negative and a positive a duplicate positive.

Film technicians prepare film labels, attend to film packaging, as well as the handling and filing of all reports. They process positive film and after it has been processed they splice it, dissect it into convenient filing lengths, and otherwise handle this useful product. Sometimes for reasons of

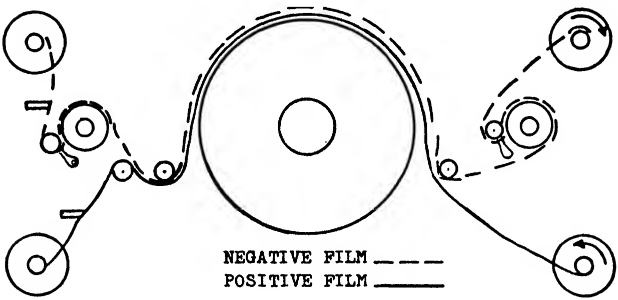
safety and convenience duplicate negatives are made from positives.

Operating the Microfilm Printer by Microstat, types P-2 and P-3 for 16 and 35 mm film, perforate or non-perforate, is done as described in these steps:

1. Read and record average density of rolls to be positive printed.
2. From density table shown, record opposite each roll density, the aperture setting to be used. (In P-3 operation, tests determine the setting.)

Average Negative Density	*Aperture Setting*
.7	.5
.8	.6
.9	.8
1.0	1.1
1.1	1.3
1.2	1.5
1.3	1.8
1.4	2.0
1.5	2.2
1.6	2.5
1.7	2.7
1.8	2.9
1.9	3.2
2.0	3.4
2.1	3.6
2.2	3.9

3. Set aperture to proper position for the first roll.
4. Turn right hand switch (lamp switch) "ON."
5. Thread negative through with the room lights on, and positive through with the lights off (except for suitable red safelight). See diagram below.



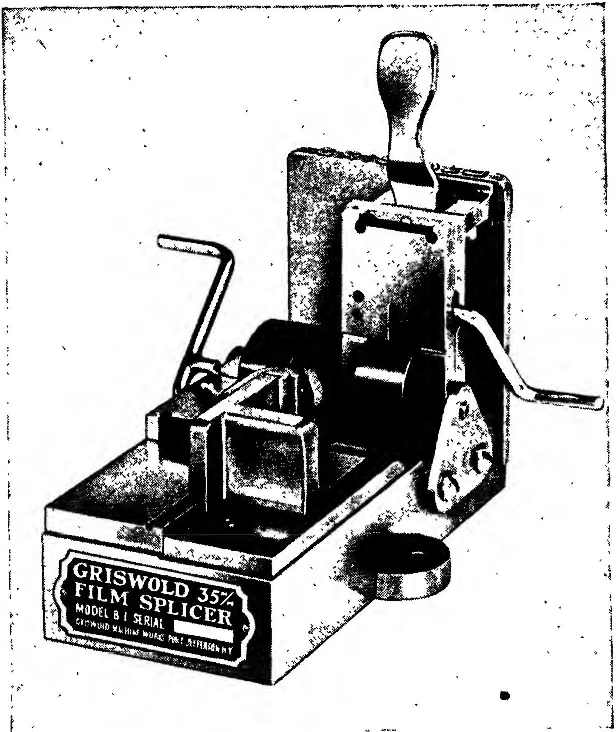
6. Adjust knob between the switches until meter hand is directly over the line.
7. Start printer by turning "ON" left hand switch.
8. Stop printer after negative has run completely through printer.

NOTE: (a) Check battery waterlevel once a week. (There are two lines on the battery to indicate proper level.) Use only distilled water when

some must be added. (This is not necessary with the P-3 printer as it operates without a charger or battery). (b) Lamp used is a Mazda #87, 6-8 volts, 15 candlepower, type S-8.

Griswold Machine Works

Splicer for 16mm microfilm, also made in 35mm width.



Griswold Machine Works

Splicer for 35mm film, new model.

The Microfilm Corporation

Microfilm Printer by Microstat, Type P-1, for 35mm film.

The Depue Microfilm Printer, widely used throughout the United States, is operated along the same lines as the Microstat apparatus except that special parts are used in conversion from 35 to 16 mm film. Both printers use friction drive and thus both avoid the hazards of sprocket wheels. Directions for using the Depue Printer:

1. Threading Instructions:

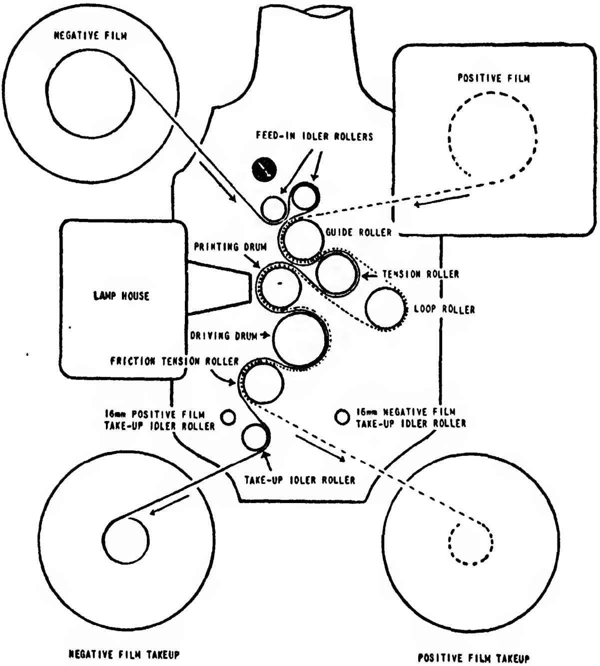
Either perforated or non-perforated film may be printed. The positive film is loaded into the magazine mounted on the upper right hand side of the main panel. The negative film is placed on the upper left hand film hub. Films are placed on the film hubs in such a manner that when passing over the printing drum the emulsion sides contact each other. The positive and negative films are threaded through the various rollers, pass between the light funnel and the printing drum, and are taken up by the positive and negative take-up flanges.

NOTE: A spring stop is provided for the rubber-covered friction tension roller. When not in use the roller should be drawn away from the driving drum in order to prevent any flattening of the rubber surface at the place of contact.

2. Change-Over for Use of 16 mm Film:

The microfilm printer may be converted for

Threading Instructions for 35 m.m.



Oscar B. Depue

the printing of 16 mm film by the following changes.

A. Replace the two 35 mm feed-in idler rollers with the 16 mm rollers which are provided.

B. Replace the 35 mm printing drum with the 16 mm printing drum.

C. Replace the 35 mm positive film magazine with the 16 mm magazine which is equipped with a special film roll guide and guide rollers.

D. Two 16 mm take-up idler rollers (one for negative film and one for positive film) are mounted on the lower part of the main panel and do not interfere with the threading or run of 35 mm film.

3. Aperture:

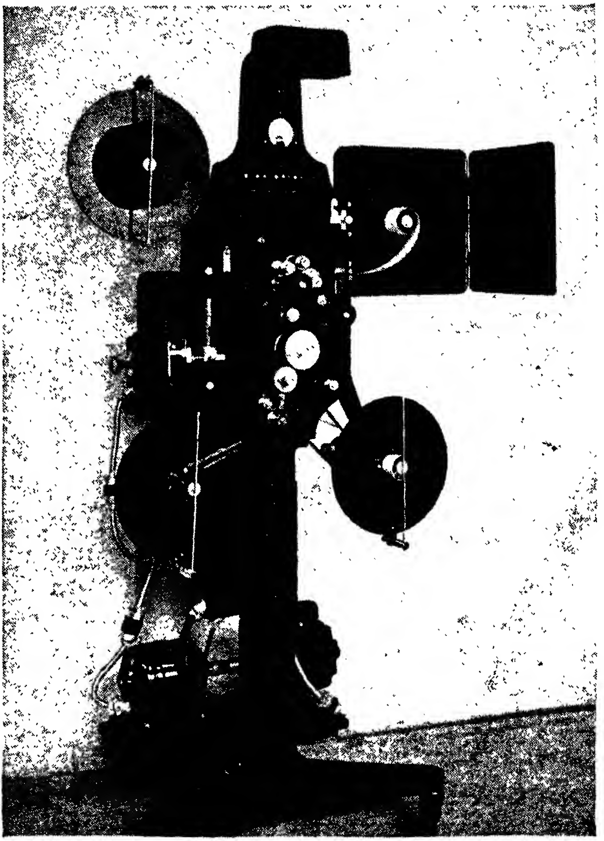
Be sure that the proper aperture is in place.

4. Circuit Breakers:

Check the automatic circuit breakers in the fuse box mounted on the rear of the pedestal column to be certain they are in the "on" position.

5. Generator Warm-Up:

When a generator is supplied turn the generator switch to "on" and allow the generator to warm up for five or more minutes to insure a steady flow of current to the picture printing light.



Oscar B. Depue

Microfilm Printer opened to show lamp housing and positive film chamber.

NOTE: Whenever the printing mechanism is temporarily stopped, allow the generator to continue running and turn off the picture light switch to prevent any damage to the film from heat of the lamp.

6. Picture Printing Lamp Socket Adjustment:

Preliminary tests must be carried out in order to determine the correct position for the picture printing lamp. Select a negative film which is of average and normal density. This should require for printing a current of 7.8 amperes or midway between the two extremes of 7 amperes and 8.5 amperes, which range is most effective for printing microfilm. The lamp should be placed in such a position that the printing beam will illuminate the aperature evenly and give uniform exposure from edge to edge. Having set the lamp in what appears to be the best possible position, mark that position and, after threading the printer with the negative and positive films expose a few feet of film. Repeat this process several times, using the same portion of the negative film but with the position of the lamp altered somewhat each time both horizontally and vertically. Develop the positive film and examine the test, selecting the result which shows the most even exposure over the entire frame. Note the lamp position used for

that particular test. This will be the proper position of the lamp for making future prints. No further adjustment of the lamp socket will be necessary unless a new bulb is installed, in which case the above tests must be repeated.

7. Current Adjustment:

In the foregoing tests to determine the correct lamp socket position, a current of 7.8 amperes was used. If results did not show the desired clarity of detail, the fault was in the amount of current used with relation to the density of that particular negative. To insure clear, sharp detail on all positive prints, it is necessary to vary the amount of current used to correspond with the varying densities of different negative films. In order to do this, a comparison strip should be made by selecting 16 negatives, each having a different density and numbering them consecutively from "1" to "16" according to the respective degrees of density and corresponding with the sixteen points on the ammeter from 7.0 to 8.5 inclusive. The lightest negative selected should be one which would print clearly on a current of 7.0 amperes. The darkest one selected should print clearly at 8.5 amperes. If each of the sixteen negatives varies in density in the same degree from the lightest one to the darkest

one, a current adjustment of 0.1 amperes in the printing of each successive step should produce a uniform positive print made from all sixteen negatives. By mounting one frame of each of the sixteen negatives in numerical order on glass over a light, the result is a comparison strip to which all future negative may be matched in order to predetermine the exact amount of current to be used in each case.

NOTE: As the lamp gets older it will tend to blacken up because of a filament deposit on the glass, and will lose some of its brilliance. Consequently it will be necessary occasionally to increase the current or amperage slightly in order to get normal exposure on the positive film. When the lamp becomes darkened to such an extent that it requires several tenths of an ampere above normal operation to obtain proper exposure, it should be discarded and replaced with a new lamp.

8. Motor Drive for Printing Mechanism:

To commence printing, turn the motor switch to the "on" position.

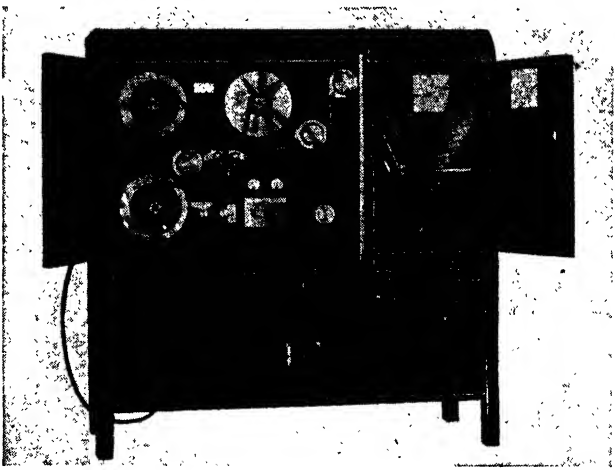
9. General:

If the microfilm printer is carefully handled, little servicing is required. All movable parts are carefully machined and fitted to very close toler-

ances, allowing smooth and free movement. No particularly heavy load or strain is put on any individual part and all parts should wear uniformly and give many years of service. In the event of breakage of any major part of the printer, it is advisable to return the broken part to the manufacturer for duplication.

10. Lubrication:

The motors should be given one drop of oil in each cup per month if the printer is used regularly. The generator should be oiled yearly.



Ozalid

Ozalid Model J Printer produces duplicate negatives or duplicate positives on ammonia gas developed diazo dyed film.

Chapter VII

ENLARGING MICROFILM

Another microfilm product is the projection enlargement. Made on a wide variety of photosensitive papers, cloth, transparent paper or acetate, the microphotographic enlargement is startling in its fidelity to the original piece of copy—printed paper, drawing, blueprint, etc., in its overall clarity. A bleached and carefully retouched projection print is many times superior to the original, as often the original is ink-spotted, folded, torn, or otherwise mutilated by time and use.

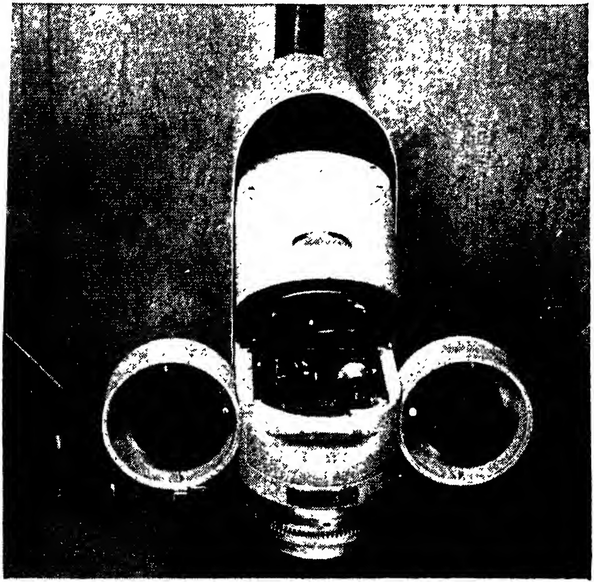
The production of such enlargements calls for high contrast developers, correct negatives, superior technique, good darkroom facilities. Any good photographer, well grounded in darkroom work, has no trouble adapting himself to the requirements for making quality projection microfilm enlargements.

Pay for this work is about the equivalent received by operators and inspectors. Rapid production, cleanliness, accuracy in following detailed orders, and good photographic technique

are essentials for success in pursuing the career of a microfilm projection enlarger.

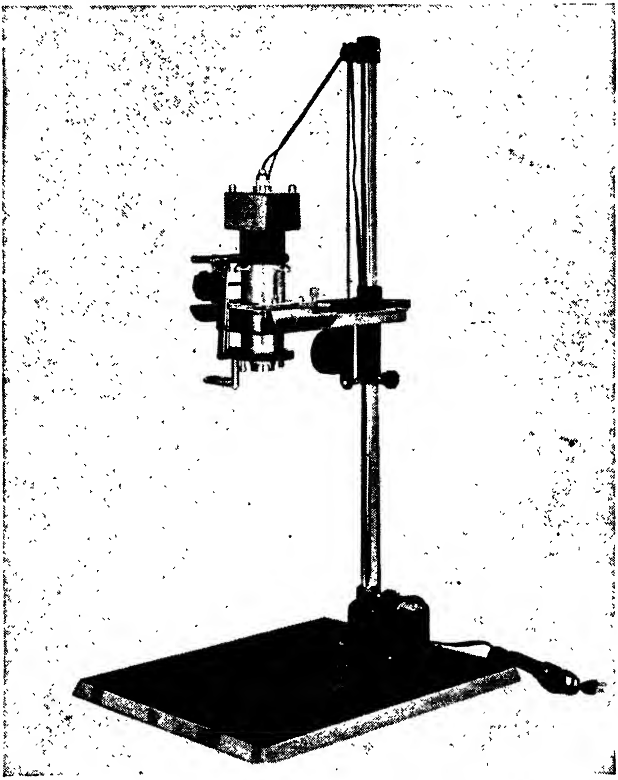
Enlarging apparatus in wide use and specially designed for microfilm includes the Eastman Precision, Leitz Focomat and Valoy, Microstat All-Purpose, Saltzman, Simmon Omega, Zeiss. Other enlargers such as the Elwood, Federal, Solar, etc., are frequently fitted for accommodating 35 and even 16 mm film. In general, the requirements for enlarging microfilm are fairly exacting. Good apparatus furnished with a condenser-corrected lighting system, scratch-free film transport, high-resolving power lens of suitable focal length, easy-to-position head, levelling adjustments for head and table, contribute greatly to success in this field.

More and more manufacturers are turning their attention to either adapting their existing apparatus to enlarging microfilm or designing special equipment. For example, the Haloid Company announces a microfilm enlarging attachment for their photocopying machine, the Rectigraph, while several photo supply catalogs feature enlargers with the added note "also enlarges microfilm." Generally, however, the best results are obtained through the use of high-precision specially designed equipment.



The Microfilm Corporation

Microstat All-Purpose Camera-Projector head opened to show bottom element of condenser, film transport, and magazines.

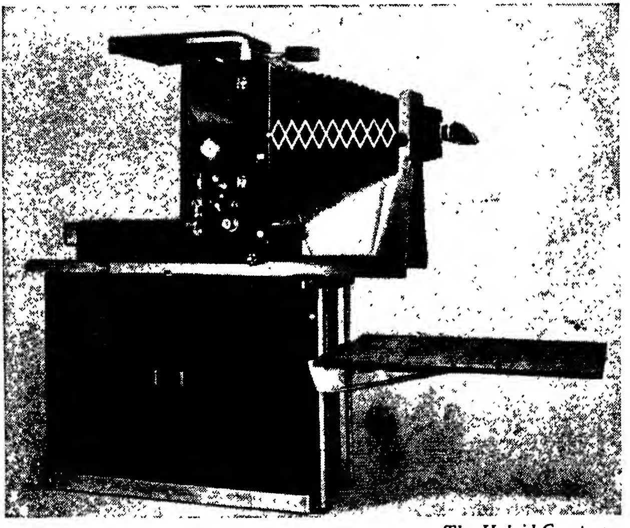


Simmon Brothers

Omega Enlarger. Special fitting provided for holding microfilm.

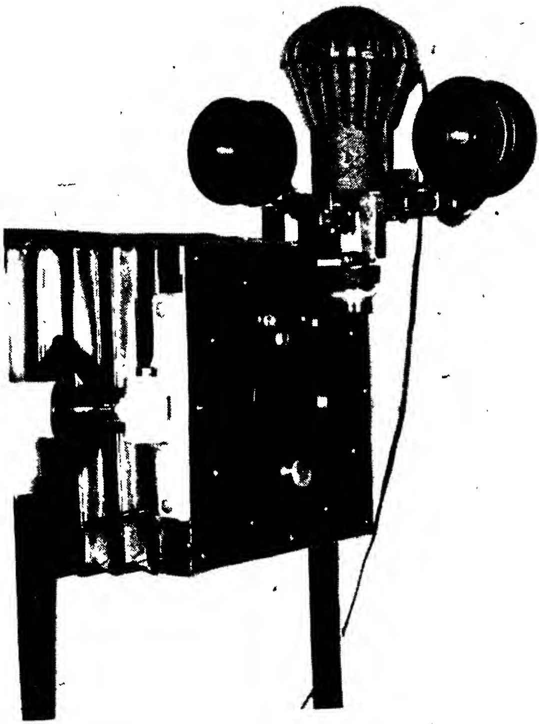
General Electric

Measuring enlarging light to determine exposure.



The Haloid Company

Rectigraph Photocopying Camera can also be used to enlarge microfilm by means of a special attachment



The Haloid Company

Microfilm enlarging attachment fitted to the lens board of a Rectigraph Photocopying Camera.

Microfilm projection enlargements are best if made from correctly exposed and developed negatives.

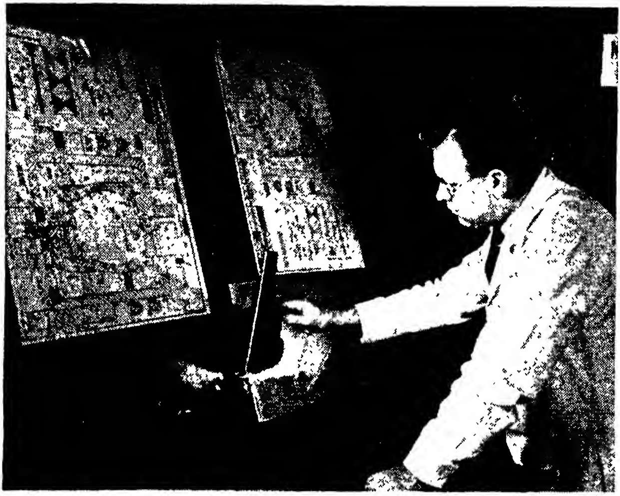
Assuming that the negative is "normal" the procedure for making paper enlargements follows:

1. Adjust the height and focus of the enlarger to the coverage or enlargement size required.
2. Position the negative in the head of the camera with the emulsion side down.
3. Position your projection speed paper, cloth, or acetate on the table and hold the borders flat by means of printers rules, a paper easel, or thumbtacks.
4. Make your exposure using an automatic timer if such is available. If you are not well acquainted with projection enlargement techniques and critical judging of negative exposure times, it is in order that paper strips be cut from sensitized material (paper, cloth, etc.), for tests: expose one inch of the strip for two seconds, one for four seconds, one for eight seconds, one for sixteen seconds, one for thirty-two seconds, etc. One or two such tests will give the right clue to correct exposure.

5. Develop all test strips and enlargements for at least 1½ minutes in developer solution at a temperature of 65° F.
6. Remove the print from the developer and place it in the acetic acid short-stop bath for at least ten seconds. This bath is made by mixing 3 ounces of 28% acetic acid in 64 ounces of water. (For greater quantities of short-stop bath increase the ingredients proportionately.)
7. Fix the print for 5 minutes in the hypo fixer. Be sure to agitate the prints thoroughly in order to insure complete fixation.
8. Wash prints in running cold tap water for not less than 30 minutes.
9. Squeegee, dry and trim. If bleaching is necessary, prepare the following Bleaching Formula and apply it locally with clean wads of absorbent cotton:

Potassium ferricyanide .	4 ounces
Water	16 ounces

Work carefully, wiping the parts to be reduced with the cotton pad saturated with the above bleach. Have a hose of running cold water handy and play it over the print as you work. From time to time set the cotton wad aside and using the flat of your palm rub the



The Microfilm Corporation

Squeegeeing microfilm enlargements preparatory to drying.

entire surface of the print. This will avoid any final evidence of spotty reduction. Now take a cotton wad full of hypo solution and work it over the face of the print. This will prevent brown staining and sepia toning of the black lines and letters. Fix again for five minutes. Wash thoroughly for another fifteen minutes before finally squeegeeing and drying.

Cloth and acetate enlargements made on projection speed sensitized cloth or on projection speed sheet acetate film are made in the manner described except that washing is shorter—only 10 minutes.

Time sequences for paper, cloth and acetate follows:

Paper

1½	minutes in developer
10	seconds in short-stop
5	minutes in fixer
30	minutes in running water

Cloth

1½	minutes in developer
10	seconds in short-stop
5	minutes in fixer
10	minutes in running water

Acetate

1½	minutes in developer
10	seconds in short-stop
5	minutes in fixer
10	minutes in running water

Bleaching is most successful with paper and acetate enlargements. When bleaching cloth extreme care must be used in controlling the tendency of the bleaching agent to brown stain and sepia tone the print. This is done by taking more

time and being sure to use plenty of water and hypo solution in rinsing the print after each short period of local or overall reduction.

Drying of paper prints is best accomplished by placing the squeegeed prints face down on the canvas belt of a rotary print dryer and regulating the heat so that it is moderate and not scorching hot. Acetate and cloth should not be put through a dryer. Squeegee them thoroughly and hang them up by snap clips or spring clothespins to a line suspended in some dust-free and warm part of the drying and trimming room.

Good projection enlargements are evidence of high precision microfilming. A good enlargement must pass all of the following requirements:

All over, corner to corner legibility.

Sharp clear lines and figures, free from photographic distortion, excessive shrinking, thinning, fattening, bleaching out, blocking up.

Careful and tone free bleaching; retouching achieved without residual evidence of this artifice.

Flat, stainfree drying.

Square trimming.

DEFECTS APPARENT IN THE PRINT

Appearance of Print	*Cause*	*Remedy*
Print is too dark.	Over-exposure.	Make new print with less exposure. Develop within specified times.
Print is too light.	Under-exposure.	Make new print with more exposure.
Print is "flat" with no brilliance.	Incorrect contrast grade of paper used for the negative or print was over-exposed and removed from developer too soon.	Use harder, more contrasty grade of paper or correct the exposure and development time as discussed on pages 26, 34.
Print is "hard" or contrasty with shadows and highlights lacking detail.	Incorrect contrast grade of paper used for the negative.	Use softer grade of paper. Correction may also be obtained to an extent by longer exposure with shorter development.
Yellow or brown stains.	Insufficient agitation in fixing bath, or exhausted fixing bath, or "forcing" in developer or incomplete washing.	Agitate prints thoroughly when in fixing bath or use acid short-stop after development. Avoid leaving prints in developer too long and give thorough washing.
White spots.	"Air-bells" on print, dirt on negative or on paper during exposure.	Slide print into developer. Keep negative and printer clean.
Black spots.	Pin holes or "air-bells" on negatives, dirt in solutions, undissolved chemicals.	For "air-bells" in negatives see No. 9.
Prints are gray and do not have clean white borders.	Paper has been fogged by unsafe darkroom light, improper developer or development too long or at too high temperatures.	Test safelight and correct developing time and temperature before making more prints.
Blistering, frilling and separation of emulsion from paper.	Solutions or wash water too warm or fixing bath or short-stop too acid. Prolonged soaking in wash water.	Correct temperature of solutions and wash water to 68° F. Replace fixer or short-stop with correctly made solution. Washing prints for more than two or three hours is undesirable.

Ansco

WEIGHTS AND MEASURES

Weights

The avoirdupois system is used in weighing solids in the United States and the British Empire. The units of measurement are pounds, ounces and grains.

1 pound = 16 ounces = 7,000 grains
1 ounce = 437½ grains

The metric system is used in most European countries and their dependencies. The unit of weight is the gram.

1 kilogram = 1,000 grams = 1,000,000 milligrams

For converting from one system to the other:

1 gram	=	15.43	grains
1 kilogram	=	2.2	pounds
1 grain	=	0.065	gram
1 ounce	=	28.35	grams
1 pound	=	453.6	grams

Liquid Measure

The metric system is used in most European countries for all measurements of liquids. It is used in all countries for scientific work because it is uniform and easy to calculate from one unit to another. The units are the liter and milliliter (commonly called the cubic centimeter). The abbreviations are l. for liter, ml. for milliliter, and cc. for cubic centimeter.

1 liter = 1,000 ml. or 1,000 cc.

The United States and Great Britain each has its own separate system of liquid measure. A U. S. gallon is not the same as a British Imperial gallon, a U. S. quart is not the same as a British quart, etc.

In the U. S. system:

1 gallon = 4 quarts = 140 fluid ounces =
1024 fluid drams = 3.785 liters

In the British system:

1 gallon = 4 quarts = 140 fluid ounces =

Chapter VIII

PHOTOCHEMICAL FORMULARY AND MICROFILM STANDARDS

Mixing photochemical solutions, however simple the formulas, calls for clean weighing and mixing utensils, exact measurements, attention to the details of each formula. Chemicals must be dissolved in the order given. Temperatures and time cycles specified must be controlled. Storage of stock solutions must be in clean containers with airtight, dustproof tops. In some instances it is important to protect solutions from sunlight. Brown glass jars or bottles are indicated.

Water is not only a mixing agent but a chemical itself. If distilled water is called for do not attempt to use tap water.

Any number of formulas are available for developing, fixing, rinsing, and testing microfilm. The same is true of formulas for developing and fixing projection enlargements made from microfilm.

Long experience teaches that it is best to become thoroughly learned in the use of one kind of film, one developer, one fixer, one completely

integrated technique of processing, before experimenting with the favorite formulas of every photographer and every photochemist. The beginner, if an experimenter, really has no basis of comparison until he or she has mastered one technique completely.

The three principal brands of microfilm negative and positive sold in the United States—Ansco, Du Pont, Eastman—are all good. All will yield good results. Millions of dollars have been spent by these film companies on research; each of them is equally anxious to satisfy its customers; each supplies tested and workable recommendations. Pick your brand, follow instructions and, if then you are unsuccessful, check your technique, your apparatus, your camera equipment. Failure due to defective film is extremely rare. Usually we discover the failure results from our own error and not the manufacturer's. If, however, the film itself is at fault, all of these companies will gladly rectify their errors in your favor. This policy holds true if you are a microfilm amateur and use only a hundred feet of film a year, or a service organization exposing at least that quantity every hour on every camera.

The formulas that follow have been tested over long periods of time on film, paper, cloth, acetate,

etc.; they can be recommended without reservation.

D-11, as modified herein, is a good developer for microfilm negatives, positives and enlargements. The contrast obtained is moderate. For greater contrast use formula PD-5.

The D-11 formula usually calls for desiccated sodium carbonate. However, monohydrated sodium carbonate is easier to dissolve and is more readily obtainable. The formula as modified contains monohydrated sodium carbonate.

The 1 quart size is for the use of operators making short run tests. The 10 gallon size is for plant processing.

D-11 (modified) MEDIUM CONTRAST DEVELOPER FORMULA

	1 quart	*10 gallons*
Warm water (125 degrees F.).	16 ounces	5 gallons
Metol (elon or pictol)	15 grains	1 ounce 162 grains
Sodium sulfite	2½ ounces	6 pounds 4 ounces
Hydroquinone	130 grains	11 ounces 390 grains
Sodium carbonate (monohyd.).	1 ounce	2½ pounds
Potassium bromide	73 grains	6 ounces 295 grains
Cold water to make	1 quart	10 gallons

To obtain standard results that are uniformly consistent do not attempt to process in old developer, at "approximate" temperatures, or in unclean apparatus. It takes only a trace of hypo in a tank or on a stirring rod to alter results. Cleanliness is of paramount importance in all

microfilming operations. The foregoing modified D-11 formula should be used on film for 11 minutes at 65 degrees Fahrenheit. If diluted 6:1 it gives a longer gray scale.

PD-5 is a very high energy developer designed to bring out the maximum contrast without sacrificing quality results. Like D-11 this formula may be used with considerable success in processing microfilm and enlargements. Note, however, that the formula calls for potassium carbonate—not sodium carbonate.

Developing time in PD-5 for Ansco Minipan, DuPont Microcopy, and Eastman Microfile, is five minutes at 68 degrees Fahrenheit. Agitate film as if using D-11 but remove after five minutes. Use full strength for film and 'stats. A gamma of 4.9 is obtainable.

PD-5 HIGH CONTRAST DEVELOPER FORMULA

	1 quart	10 gallons
Warm water (125 degrees F.)	16 ounces	5 gallons
Metol (elon, pictol, or rhodol)	22 grains	2 ounces
Hydroquinone	220 grains	1 pound 4 ounces 50 grains
Sodium sulfite	2 ounces	5 pounds
Potassium carbonate	2 ounces	5 pounds
Potassium bromide	66 grains	6½ ounces
Cold water to make	32 ounces	10 gallons

Acid hardener-fixer formula sufficient to make 50 gallons follows. All ingredients listed may be purchased in the quantities shown from Ansco, Eastman, Edwal, Mallinckrodt, and other reliable sources supplying photographic chemicals.

Apparatus:

1 50-gallon oak stave wax-lined barrel complete with removable top lid and acid proof spigot. Wax impregnated wooden wine taps are satisfactory. Label the barrel "FIXER FOR FILM."

1 large size stirring paddle used exclusively for hypo.

Chemicals:

100 pounds pea crystal hypo (sodium thiosulfate)
5 pounds sodium sulfite (desiccated)
1 pound boric acid crystals
5 pounds glacial acetic acid
5 pounds potassium alum

Method of Mixing:

Fill the barrel with approximately 30 gallons of warm water (about 125 degrees Fahrenheit) and add 100 pounds of pea crystal hypo. Stir until completely dissolved. This takes about four minutes. Dissolve 5 pounds of sodium sulfite in this mixture. Add 1

pound of boric acid crystals and dissolve. Begin adding cold water to the barrel by means of a hose or conveniently located water tap. Slowly and carefully add the contents of the 5-pound bottle of glacial acetic acid. Stir the mixture rapidly and have an assistant add the acid. This part of the procedure should take about one full minute. Finally add 5 pounds of potassium alum and sufficient cold water to bring the total volume of the acid hardener-fixer to 50 gallons. Be sure that all ingredients are thoroughly dissolved. Put the lid on the barrel and rinse off the paddle. Always compound the ingredients of this formula in the order named.

MICROFILM FIXER FORMULA:

Water (about 125 degrees F.)	30 gallons
Hypo crystals (prismatic sodium thiosulfate)	100 pounds
Sodium sulfite, desiccated	5 pounds
Boric acid crystals	1 pound
(Begin adding cold water)	
Glacial acetic acid	5 pounds
Potassium alum	5 pounds
Cold water to make	50 gallons

Small quantities of fixer adequate for clearing test strips after development may be made by simply dissolving hypo crystals in warm water and using the solution at 65 degrees F.

For comparison between the three systems:

Metric		U. S.		British
1 liter	=	33.81 fluid ounces	=	35.20 fluid ounces
1 cc.	=	0.2705 fluid dram	=	0.2816 fluid dram

Photographic Practice

Accurate conversion of formulas from one system to the other results in awkward numbers and fractions. For making up most photographic solutions the fractions can be ignored. The common practice in the United States is to use the following approximate equivalents:

WEIGHTS

U. S. Units		Metric
15 grains	....equivalent to	1 gram
1 ounce	.....equivalent to	30 grams
1 pound	....equivalent to	450 grams
2.2 pounds	...equivalent to	1 kilogram

LIQUID MEASURE

1 fluid dram	..equivalent to	3.7 cc.
1 fluid ounce	..equivalent to	30 cc.
32 fluid ounces	equivalent to	1 liter
1 gallon	.....equivalent to	4 liters

Convenient Conversion Values

Many professional photographers convert formulas from Metric to U. S. Units and the reverse by using the following multiplying factors:

FOR SOLIDS

Metric Grams per Liter × 14.6 = U. S. Grains per Quart
Metric Grams per Liter × 0.0334 = U. S. Ounces per Quart
U. S. Grains per Quart × 0.0685 = Metric Grams per Liter
U. S. Ounces per Quart × 29.96 = Metric Grams per Liter

FOR LIQUIDS

Metric CC per Liter × 0.032 = U. S. Fluid Ounces per Quart
U. S. Fluid Ounces per Quart × 31.25 = Metric CC per Liter

MICROFILM TEST STRIP FIXER FORMULA:

Water (about 125° F.)	64 ounces
Hypo crystals	1 pound

This formula should not be used, however, if the film is designed for record preservation purposes.

SHORT-STOP FORMULA:

Water (65° F.)	64 ounces
Acetic Acid 28% *	3 ounces

The following fixer formula for enlargements has the particular advantage of completely depinking sensitized papers and other red-dyed reproduction substances used in making projection enlargements. However, it must not be used for microfilm.

FIXER FORMULA FOR ENLARGEMENTS:

Formula for 50 Gallons:

Water (about 125° F.)	40 gallons
Hypo crystals (prismatic sodium thiosulfate)	100 pounds
(Dissolve completely and add):	
Sodium bisulfite	25 pounds
Cold water to make	50 gallons

Formula for 1 Gallon:

Water (about 125° F.)	1 gallon
Hypo crystals (prismatic sodium thiosulfate)	2 pounds
Sodium bisulfite	8 ounces

* 28% acetic acid may be prepared from 99% glacial acetic acid by diluting 3 parts of glacial acetic acid in 8 parts of water.

HYPO ELIMINATION TEST SOLUTION, may be prepared according to the following National Bureau of Standards formula:

Distilled water	32 ounces
Mercuric chloride	25 grams †
Potassium bromide	25 grams †

Prepare by first dissolving the mercuric chloride in 16 ounces of distilled water, adding and dissolving the potassium bromide, adding sufficient distilled water to make 32 ounces. Label: Hypo Elimination Test Solution—"POISON."

FILM RINSE STOCK SOLUTION, an effective aerosol wetting agent used preparatory to drying microfilm and as a sponge conditioner, may be prepared as follows:

> Dissolve 2 ounces of 25% aerosol in 128 ounces of distilled water. Filter and bottle.

Dilute one-to-one for use in sponge dishes. For use in unloading pans: add 2 ounces of the stock solution to every pan of water.

Persons using photo-chemicals may be affected by mild skin or nail irritations and discolorations. A formula useful in cleaning the hands is given and a barrier protection skin cream is recommended.

† 25 grams is equivalent to 5 five-cent pieces as each U. S. nickel weighs 5 grams.

HAND STAIN REMOVER

Solution A—Water		32 ounces
	Potassium ferricyanide	1 ounce
	Potassium bromide	1 ounce
Solution B—Fixer for film		32 ounces

Rub the hands and stained fingers in Solution A; rinse in running water; immerse in Solution B; wash thoroughly. Do not use Solution B for any other purpose. Keep the two solutions bottled and handy for use. Label: "Hand Stain Remover—Solution A" and "Hand Stain Remover—Solution B."

SKIN CREAM

A water repelling barrier protecting skin cream useful in buffering the action of strong as well as dilute acids and alkalies contained in photochemicals is FEND-I. The cream should be applied before work, rubbed in well between the fingers and about the fingernails, removed with mild soap and water before meals. FEND-I is packaged in pint jars by The Mine Safety Appliances Co., Pittsburgh, Pa.

Edwal Laboratories offers the following useful rules for successful hot weather processing:

Develop films as soon as possible after exposure.

Know the temperature limitations of the particular developers you are using.

Control the temperatures to within those limits

or add Edwal Thermosalt to developer, short stop and hardener.

Keep the temperatures of all the film processing solutions as uniform as possible.

Keep films and camera out of hot places.

Check your thermometer so that you know it is accurate.

Standard for Temporary Record Photographic Microcopying Film

(Gelatin-Silver Halide Emulsion Type)

The exposed and processed film shall be of such a type that no serious loss in the quality of the image shall result within five years after processing when the film is kept under ordinary storage conditions. All film shall be of 16 mm or 35 mm size either perforated or unperforated as specified.

Detailed Requirements

Film Base:

The film base shall be the slow burning cellulose-acetate type known as "safety" film. The thickness of the film base and emulsion shall be 0.0055 ± 0.0010 inch.

Emulsion:

The emulsion or light sensitive coating shall be composed of silver-halide crystals of a size distribution entirely suitable for microcopying use, uniformly dispersed in a thin layer of high grade gelatin on one side of the film base. The white-light and spectral sensitivities shall be such that accurate and complete copies of the documents are obtained with the usual exposure and development technique.

Processing:

The film shall be developed with the usual organic developing agents such as "Metol," hydroquinone, glycin, etc., compounded to produce a silver image essentially black. Developers producing stained or colored images are not to be used. The films shall be fixed in the usual sodium thiosulphate fixing bath. Fixing baths containing ammonium thiosulphate shall not be used. No intensification or reduction of the developed image is permitted.

Hypo Content of Emulsion:

The hypo (sodium thiosulphate) content of the processed film shall not exceed 0.02 mg per square

inch of film. The hypo content shall be determined by the method of Crabtree and Ross in the *Journal of the Society of Motion Picture Engineers*, Vol. 14, p. 419 (1930).* One square inch of film (1⅝″ of 16 mm film or ¾″ of 35 mm film) is immersed in a shell vial ¾″ x 4″ containing 10 ml of the following solutions:

Potassium bromide	25 grams
Mercuric chloride	25 grams
Water to make	1 liter

After the sample has remained in the above solution for 15 minutes the turbidity is compared with that of three similar shell vials containing the above solution, one with no hypo, one with 0.02 mg, and one with 0.03 mg hypo (Na_2S_2O). The comparison is made in a darkened room using a mercury lamp for illumination. The shell vials should rest on a black surface, the light entering from one side of the vials. The criterion is that the turbidity of the tested solution should not exceed that of the one having 0.02 mg of hypo.

* In this article (p. 426) the sensitivity of the mercuric chloride test is given as 0.05 mg of hypo without stating the volume of solution or area or length of film. This value is obviously for 1 foot of film since with ordinary care 0.005 mg per frame of 35 mm film (1 square inch) is detectable.

Flexibility:

Flexibility is determined by means of a Pfund folding endurance tester used as described by Weber and Hill, National Bureau of Standards Miscellaneous Publication M158, obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., price 5 cents.

Processed film, conditioned at 65% relative humidity shall stand at least 16 single folds in the Pfund tester (19 mm between jaws) without breaking. Film aged 72 hours at 100° C. and conditioned at 65% relative humidity shall not lose more than 25% in folding endurance of the original sample.

Burning Time Test:

A sample 16 inches long shall be cut from the 16 mm or 35 mm film to be tested. All gelatin layers shall be removed by washing in warm water or treatment with an enzyme such as pancreatin. After drying for at least 24 hours, the sample shall be marked 2 inches from each end and perforated with holes approximately 0.12 inch in diameter along one edge at intervals of about 1¼ inches, if sample is not already perforated. A wire having a diameter of not more

than 0.020 inch shall be threaded through the perforations on one side at points approximately 1¼ inches apart.

The wire holding the dried sample is stretched horizontally between two supports permitting the sample to hang vertically from it. The bottom corner of one end of the sample is ignited. The time which elapses from the moment the flame reaches the first mark until the flame reaches the second mark shall be recorded as the burning time. If the sample does not ignite or if it does not completely burn, the burning time is recorded as infinite. The test shall be made in a room free from draughts. At least three tests shall be made. The burning time shall not be less than 45 seconds.

National Bureau of Standards,
October 25, 1943.

Standard for Permanent Record Photographic Microcopying Film

(Gelatin-Silver Halide Emulsion Type)

The exposed and processed film shall be of such a type that the quality of the image shall remain permanent under ordinary storage conditions. All film shall be of approved type of 16 mm or 35 mm size either perforated or unperforated as specified by the purchaser. Several manufacturers are making microcopying film to comply with this standard. Whenever practicable it is recommended that the approved types of film be used since it not only greatly reduces the number of expensive tests but also assures the user, with reasonable certainty, that film suitable for permanent records is being used. Permanent record type of microcopying film which has received the approval of the National Bureau of Standards may be identified by a solid triangle after the word "safety" in the edge marking of the film.

Detailed Requirements

Emulsion:

The emulsion or light sensitive coating shall be composed of silver-halide crystals of a size dis-

tribution entirely suitable for microcopying use, uniformly dispersed in a thin layer of high grade gelatin on one side of the film base. The white-light and spectral sensitivities shall be such that accurate and complete copies of the documents are obtained with the usual exposure and development technique.

Processing:

The film shall be developed with the usual organic developing agents such as "Metol," hydroquinone, glycin, etc., compounded to produce a silver image essentially black. Developers producing stained or colored images are not to be used. The films shall be fixed in the usual sodium thiosulphate fixing bath. Fixing baths containing ammonium thiosulphate shall not be used. No intensification or reduction of the developed image is permitted.

Hypo Content of Emulsion:

The hypo (sodium thiosulphate) content of the processed film shall not exceed 0.005 mg per square inch of film. The hypo content shall be determined by the method of Crabtree and Ross in the *Journal of the Society of Motion Picture En-*

gineers, Vol. 14, p. 419 (1930)*. One square inch of film (1⅝″ of 16 mm film or ¾″ of 35 mm film) is immersed in a shell vial ¾ x 4″ containing 10 ml of the following solutions:

Potassium bromide	25 grams
Mercuric chloride	25 grams
Water to make	1 liter

After the sample has remained in the above solution for 15 minutes the turbidity is compared with that of three similar shell vials containing the above solution, one with no hypo, one with 0.005 mg, and one with 0.010 mg hypo ($Na_2S_2O_3$). The comparison is made in a darkened room using a mercury lamp for illumination. The shell vials should rest on a black surface, the light entering from one side of the vials. The criterion is that the turbidity of the tested solution should not exceed that of the one having 0.005 mg of hypo.

Flexibility:

Flexibility is determined by means of a Pfund folding edurance tester used as described by Weber and Hill, National Bureau of Standards

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Miscellaneous Publication M158, obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., price 5 cents.

Processed film, conditioned at 65% relative humidity, shall stand at least 16 single folds in the Pfund tester (19 mm between jaws) without breaking. Film aged 72 hours at 100°C and conditioned at 65% relative humidity shall not lose more than 25% in folding endurance of the original sample.

Film Base:

The film base shall be the slow burning cellulose-acetate type known as "safety" film. The thickness of the film base and emulsion shall be 0.0055 ± 0.0010 inch.

Relative Viscosity:

Four strips of processed film weighing 1.000 g. each are cut from the sample. Two of the strips are aged at 100°C for 72 hours. Each of the strips is dissolved in approximately 95 ml of reagent grade acetone in 100 ml volumetric flasks. Solution may be effected by repeated shakings for one to two hours or allowing it to stand over-night. After solution of the film base is completed and the emulsion has settled to the bottom, the flasks

are immersed in a water bath maintained at $30 \pm 0.05°C$. When temperature equilibrium has been reached and the volume of the solution adjusted to 100 ml, a 5 ml portion is transferred to an Ostwald pipette immersed in the same constant-temperature bath. The time of flow of the solution through the capillary of the pipette is measured to at least one-fifth second. The time of flow is also measured for a 5 ml portion of the pure solvent. Not less than three readings should be made for each 5 ml portion. The relative viscosity is then calculated as the ratio of the time of flow of the solution to the time of flow of the solvent. Duplicate determinations shall be made on both the original and aged film sample and the duplicates should agree within five-tenths of a second. The change in relative viscosity caused by aging shall not exceed 5%.

pH Stability:

Four strips of processed film weighing 1.00 g. each are cut from the sample. Two of the strips are aged at 100°C for 72 hours. Each strip is placed in a 200 ml Erlenmeyer flask and dissolved in 100 ml of acetone-water solution containing 10 percent by volume of water. Solution may be effected by repeated shakings for one to two hours or allowing it to stand over-night. After

solution of the film base is complete the pH of the solutions is measured with a glass electrode. The change in pH between the original and aged samples shall not exceed 0.5 pH unit. Duplicate determinations shall be made on both the original and aged film sample and the duplicate shall agree within 0.1 pH unit. Both the water and acetone shall be purified by distillation.

Nitrogen Content:

The film base shall not contain more than 0.15% nitrogen as cellulose nitrate. The determination for nitrogen shall be made as follows:

Two grams of film base, emulsion removed, are placed in an 800 ml Kjeldahl flask. Ninety ml of 30% sodium hydroxide and 10 ml of ethyl alcohol are added. The sample is heated on the steam bath or over a low flame and 25 ml of 30% hydrogen peroxide are added slowly with agitation using a stirring rod or shaking the flask. When the first portion of hydrogen peroxide is boiled out, another 25 ml portion of hydrogen peroxide is added which is usually sufficient to dissolve completely the film base. The contents of the flask will now be about 200 ml.*

* When evaporating the solution following the peroxide digestion, mechanical loss by entrainment may occur if the solution is boiled down too far. This will give low results.

The solution is evaporated over a flame to about 75 ml volume to remove the last traces of ammonia, diluted to a total of 350 ml with distilled water, cooled, and immediately before connecting the flask to the Kjeldahl apparatus, 2.5 grams of DeVarda's alloy are added quickly.† About 200 ml of distillate are collected in a 500 ml Erlenmeyer flask containing 50 ml of standard tenth-normal sulphuric acid.‡ The excess acid is back titrated with tenth-normal sodium hydroxide using methyl red as indicator.

A blank determination is made on the reagents using the same quantities that are used in the actual determination. (The difference in the number of milliliters of hydroxide required for the blank and the sample, multiplied by 0.07, gives the percentage of nitrogen.)

National Bureau of Standards,
September 14, 1943.

† The total volume of the sample at the time of the addition of the DeVarda's alloy must be closely controlled. Too much or too little water added changes the alkali concentration so that the rate of reaction with the alloy and the corresponding reduction of the sodium nitrate present will be erratic.

‡ When distilling the sample after addition of the DeVarda's alloy, some alkali may be carried over into the standard acid by entrainment if the distillation is carried too far or is too vigorous. This will give high results.

Chapter IX

READING AND FILING MICROFILM

Many users of microfilm like to view their positive film files by projection. Microfilm projectors are made by Argus, Bausch & Lomb, Eastman, Leitz, Spencer, SVE, and Zeiss. The better quality projectors are fitted with high grade optical and lighting systems. In fact the main item of cost in the very best projectors obtainable is usually the lens.

Semi-darkened rooms are required when reading microfilm by projection and for this reason projectors are not nearly as popular as self-contained reading devices. Flat mat-white screens, white or light painted walls, are far superior and less costly than the beaded screens so widely used by motion picture fans.

Microfilm readers, or reading machines as sometimes called, are designed to either project the film image directly onto a flat light-colored surface within a shadow box, as in the Junior Recordak and the Spencer Microfilm Reader, or onto an opal or ground glass screen as shown in the illustrations of the Remington Rand, Micro-

E. Leitz, Inc.

The Leitz Desk Viewer for examining low reduction microfilm.

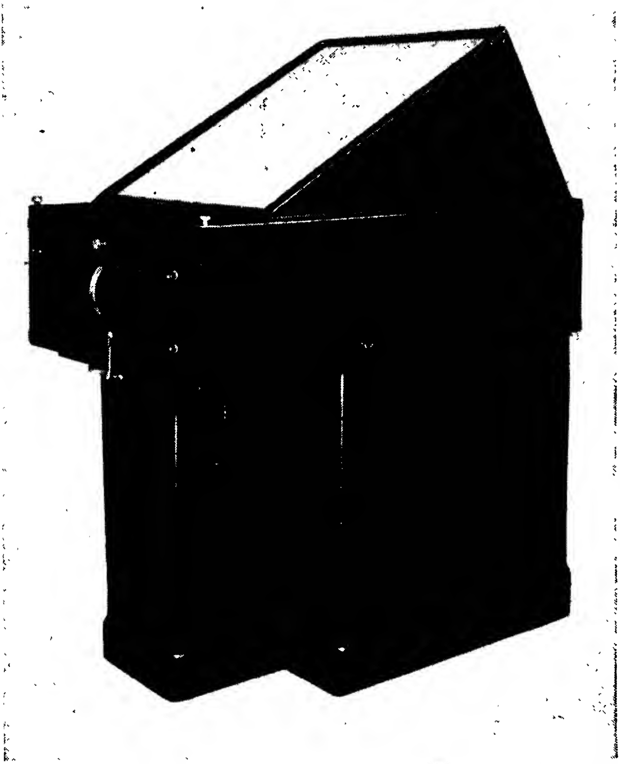
stat, Recordak Library Model C, and SVE apparatus.

Among the simpler and less expensive microfilm viewing devices are the Spencer Microfilm Reader, the Novex Reader-Projector, the SVE Microfilm Reader. The Spencer apparatus is made for single-frame 35mm film. A 100 watt projector lamp illumines the film carried in a glass film book, projects its image through a lens onto a specially tinted paper screen placed in the bottom of the 14 inch square base of the shadow box. The Novex Reader-Projector, made for double-frame 35mm film, projects onto a 7 inch square ground glass or, by merely tilting the head assembly and refocusing, projects the image onto a wall or other screen surface. The SVE (Society for Visual Education) Microfilm Reader operates so that the projected image is cast from one mirror to another and finally onto a 12 inch square translucent glass screen. The film transport accommodates 100 foot rolls of 35mm film, perforate or non-perforate. The reader is compact and when folded is not much larger than a portable typewriter case.

Better quality microfilm reading devices, although more costly, are well worth the price to users. Such apparatus has been designed by Re-

cordak. Notable examples are their Film Reader model 10, their Library Film Reader model C, which takes both 16 and 35mm film. The head of the model C rotates in a 360 degree circle permitting the reader to view the image in any position. Easy to operate adjustments are provided for changing the magnification and correcting the focus.

Most recent development in readers is the Microfilm Reader by Microstat, type R-1. Mounted in a lectern style cabinet it is comfortable for the person using it, sitting or standing, quickly scanning or painstakingly tracing the images shown. An 18 by 24 inch opal glass screen surmounts the machine. A 300 watt tubular projector lamp, cooled by an exhaust fan, has its light condensed by three plano-convex lenses. This light passes through the film and the two-inch focal length f3.5 precision lens. Magnifications from 13 to 26 diameters are obtainable by merely pressing a button controlling a motor mechanism within the cabinet. This mechanism moves two aluminized mirrors and thus provides for variable magnification from 13 to 26 diameters. Turret rotation of the film transport is 360 degrees. The film itself may be driven electrically forward or in reverse, at 100 feet a minute or a



Microstat Corporation

Microfilm Reader by Microstat, Type R-1, for engineers and executives is electrically controlled.

frame at a time. Thirty-five millimeter perforate or non-perforate can be used.

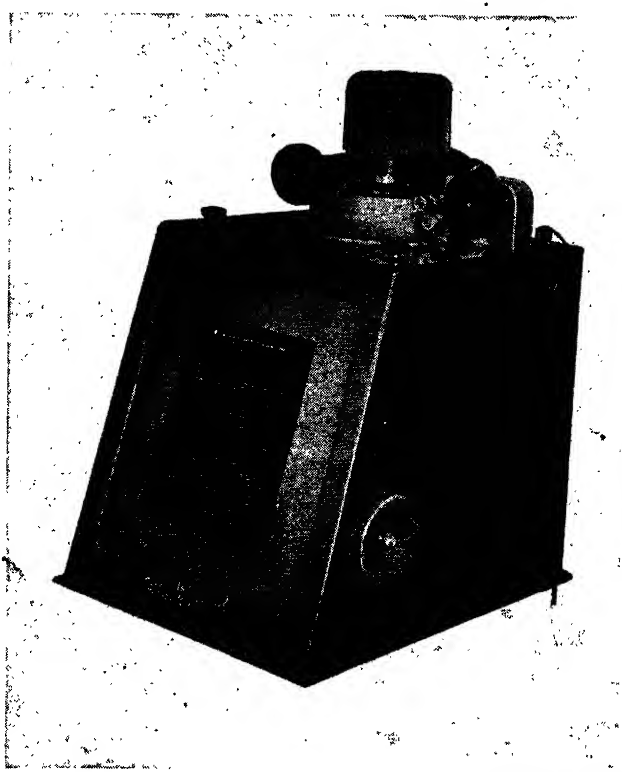
Somewhat less complex reading devices, adequate for viewing office papers on film, are supplied by the Pathe Manufacturing Company and by Graphic Microfilm Service.

The Remington Rand Film-a-record reader projects 16 mm. microfilm back to full letter size. A lever arrangement makes it possible to read the images no matter which way they were filmed—sidewise or upside down. A large 14 x 15½ inch viewing screen is provided as well as a device which makes it possible to use the instrument as an enlarger.

The filing of microfilm should present no difficulties. Rolls of microfilm, packed in boxes or metal containers, are appropriately labeled and filed in the same manner as the originals they represent. Subject matter is indexed alphabetically, geographically, numerically, or by subject heading. Location of such files for reference is just as easy as with full-size files, with the added convenience brought about by space-saving and the handling of small objects. Filing systems have been elaborated by most of the large service organizations. Indices are provided with inspected film, and render ready-reference facilities.

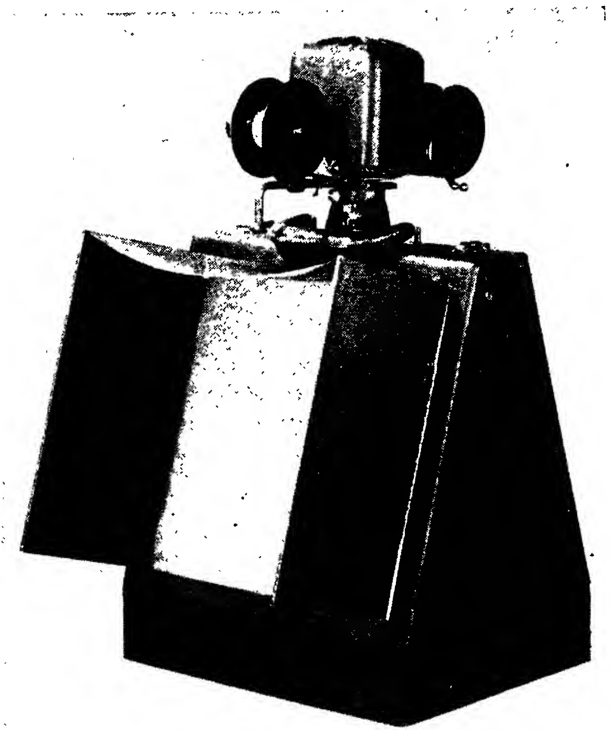
Recordak Corporation

Recordak Library Reader, Model C, accepts 16 or 35mm film.



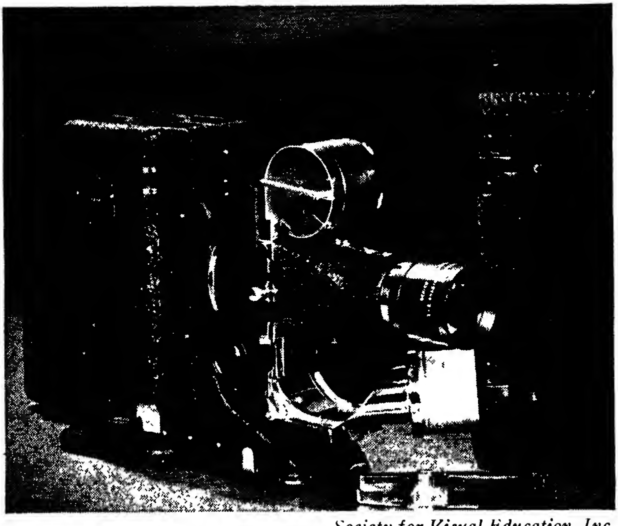
Remington Rand

Film-A-Record 16mm Microfilm Reader designed for desk use.



Society for Visual Education, Inc.

SVE Reader when folded into portable case permits use while traveling.



Society for Visual Education, Inc.

SVE Projector and case. Lecture demonstrations are aided by slide film produced on microfilm cameras. Black-and-white as well as tinted and full color film is shown by projection.

Microfilm filing presents a problem to which at least the following partial solutions have been given:

1. Place appropriate title charts or "targets" at the beginning and end of each roll of microfilm. On such charts print the title of the records, indicate their owner, show a prominent roll number or letter, state the first and last record microfilmed on the roll. Repeat this information, reduced to its essence, on the container holding the microfilm roll. For example: "Roll 99, XYZ Corporation, Salt Lake City, Utah, Employee Roster May 24, 1899, to May 24, 1909," would appear on the roll of film at either end as well as on the container. Microfilm containers such as paper labelled cans, heat embossed plastic screw-top jars, cardboard boxes, may carry this same information in abbreviated form as "Roll XYZ, Employ. 5-99 to 5-09."
2. Assign and place a serial letter or letter and successive number on each background for every record microfilmed. Thus an engineering tracing pertaining to gas engines might appear on the film with this caption: "Gas Eng. A-24597a." Assuming that all the

engineering tracings pertaining to gas engines, to continue this example by way of illustration, are numbered in consecutive order, or if not, are keyed together in an index, the problem of filing and finding any one of them on the microfilm is simplified by the indicated method.

3. After the master negative has been made, print a positive of this and cut the positive roll into one-foot-long segments of eight frames each. Place the eight-frame film strips in bond paper or Filmdex acetate envelopes and label appropriately. These film strips may be filed in shallow boxes or file cabinet trays in the same manner as the originals they represent.
4. From a positive film print of the master negative it is even possible, but seldom desirable, to cut out each individual frame and file it in a separate envelope, or affix it to a cut-out Filmdex filing card of the type patented by A. N. de Sherbinin for holding and viewing color film transparencies.
5. A variant of solution number 4 is to place each individual frame of film on an IBM punch card. A window opening in the card permits viewing the film and the punched

Spencer Lens Company

Spencer Microfilm Reader fitted with 100 foot reel attachment.

holes facilitate finding the record required by passing the cards through the IBM card selecting apparatus.

6. Contact print the negative film on photographic paper and view by reflection in a Readex reader or by transmitted light under a binocular microscope or other suitable source of magnification. Such prints may represent a series of related records, may be made to file and find individual items. As many as 100 film frames may be printed on a single piece of paper. If the paper is double coated, they may be printed on both sides—thus doubling the capacity.

Glossary

GLOSSARY OF TECHNICAL AND TRADE TERMS

A

Abrasive Paper—Silicon Carbide Paper used to scour Stineman reels.

AC—abbreviation for *Alternating Current.*

Acetate, Cellulose—a fire-resistant film base.

Film—safety film made of cellulose acetate.

Acetate—a reproduction made on acetate film; used in projecting sectionalized reproductions, reduced area reproductions, as a duplicate tracing for contact printing diazo prints and blueprints.

Acetic Acid, Glacial—99% *Glacial Acetic Acid* used in compounding fixer for film.

28%—a less concentrated acid used in making short-stop bath.

Acid—a hydrogen compound capable of uniting with an alkali to form a salt. Fixer formulas for film and reproductions are acid in action and therefore must never be allowed to contaminate developer which is alkaline.

Acid Fixing Bath—see *Fixer for Film.*

Aerosol—a wetting agent used in rinsing microfilm because it releases surface tension, sheds

water, avoids water spotting, hastens drying.

Air Bells—clear white spots seen on carelessly processed film. Air bells result from insufficient agitation and from the use of exhausted developer.

Airgraph—British V-Mail System.

Alkali—a base compound that will neutralize an acid. For example, developer is alkaline and neutralizes the acid in fixer for film and reproductions. Therefore the fixer has to be changed frequently. Alkalies used in developers are sodium hydroxide, ammonia, trisodium phosphate, potassium carbonate, sodium carbonate, potassium metaborate, Kodalk, borax, etc. These alkalies are added to developers because of their vigorous action in accelerating the action of the developing agents.

Alum, Potassium—a compound used in preparing fixer for film.

Ampere—unit of electric current strength.

AMA—American Microfilming Association.

Ansco—manufacturer of photochemicals, *Minipan* microfilm, color film, contact and projection speed papers, apparatus.

Ansco Color—full color film useful in microfilming color work; for projection purposes

especially. Made by Ansco Division of General Aniline and Film Corporation.

Aperture Setting—the effective f-stop for a calibrated lens; the point at which it gives the sharpest focus without too greatly cutting down the light.

Area Projected Background—the space covered by the image cast by an enlarger.

Argus—35 mm amateur camera useful in low reduction microfilming where great precision is not important.

ASMPE—American Society of Motion Picture Engineers. Their monthly publication, the *Journal*, contains articles of interest to microphotographers.

B

Background—waterproof glazed white paper or neutral gray paper cut to a predetermined size and used to cover a camera table during microfilming operations.

Background Scale—indicator of reduction ratio placed on background.

Bath, Short-Stop—an acid solution used in making enlargements.

Bausch & Lomb—manufacturer of lenses and film projectors.

Bausch & Lomb Micro-Tessar—a microfilming lens made by Bausch & Lomb.

Bichromate, Potassium—a compound used in developing blueprints.

"Bites"—a colloquialism for *Multiple Exposures.* For example, a large drawing exposed in "nine bites" has been taken in nine overlapping sections, each on a separate exposure of equal density.

Black-and-White—a phrase applied to copying processes capable of producing black lines on a white background. Positive microfilm, diazo black-and-white prints, are examples.

Blanks—unexposed microfilm frames.

Bleaching—a photographic reduction process used in removing background and excessive silver deposits from reproductions.

"Blow Up"—to make a reproduction by projection enlargement.

Blueprint—a copy having white lines or figures on a blue background.

Blurring—a loss of image detail due to camera vibration, graininess of the negative, improper processing and drying, camera out of focus.

Boric Acid—a mild acid used in compounding fixer for film.

Bromide Paper—photographic paper of long scale sometimes used in producing reproductions of delicate halftones, other photographs, etc. Typical papers are Velour Black, Brovira, Kodabromide, Halobrom.

Bruning Process—the BW diazo process of reproduction, also the CB process of reproduction on cloth from a Van Dyke negative. Supplied by Charles Bruning Co., Inc.

Bulbs—see *Lamps.*

BW—the Bruning black-and-white process of diazo dye reproduction by contact.

C

Calibration—precision focusing.

Camera, Argus—inexpensive amateur 35 mm. camera for simple microfilming work made by International Industries.

Contax—superior grade amateur 35 mm. camera for more advanced microfilming made by Zeiss.

Film-a-record—16 mm. professional camera made by Remington Rand.

Graphic—professional microfilm cameras made by Graphic Microfilm Service.

Leica—amateur 35 mm. camera made by Leitz

and supplied with many excellent accessories.

Microstat J-7—a professional microfilming apparatus combining camera and projector made by Microstat Corporation.

Pathe—made by the Pathe Mfg. Co.

Photorecord—professional microfilm cameras made by Folmer-Graflex.

Recordak—professional microfilm cameras made by Recordak—subsidiary of Eastman.

Carbonate, Potassium—developing alkali.

Sodium—developing alkali.

CB—a Bruning process for making cloth reproductions by contact printing from a specially prepared Van Dyke exposed in a vacuum frame and carefully retouched.

Cellulose Acetate—the fire-resistant base of microfilm.

Cement, Film—a special cement made for splicing acetate film.

Changing Bag—a lightproof cloth bag used to transfer exposed microfilm test strips into five-foot developing tanks; also used in loading and unloading film.

Chemical Fog—fogging of film due to exposure to chemicals or contamination in any of the processing steps.

Chief Inspector—an individual in charge of other microfilm inspectors, processors, and film clerks.

Chief Operator—an individual in charge of a camera crew as well as being an active working member of the camera crew.

Chief Processor—an individual in charge of a processing darkroom crew as well as being an active working member of the processing crew.

Circle of Confusion—the image formed by a lens of a point of light is never a perfect mathematical point due to the imperfection of all lenses. Instead of a point, the image forms a disk of light. The diameter of this disk is called the circle of confusion. A circle of confusion of 1/100 inch is the boundary between a print being sharp or unsharp when held at the normal viewing distance of ten inches from the eyes of the observer. All flat field lenses are specially corrected in order to diminish this circle of confusion to the minimum obtainable.

Classified—a term applied to confidential and secret records that must be microfilmed under Army or Navy surveillance.

Clerk, Film—an individual charged with the du-

ties of assisting inspectors in billing, labelling, wrapping, shipping and ordering retakes of microfilm.

Clips, Film—spring fasteners used in holding short lengths of film while drying.

Cloth—a reproduction made on sensitized waterproof cloth and used as a duplicate tracing from which diazo prints and blueprints are produced.

Color-Blind—emulsions sensitive only to blue and violet light; very slow speed.

Compression—word applied to describe the space-saving character of microfilm in the duplication of records.

Condenser—usually two plano-convex lenses which focus the light of an enlarger lamp.

Contact Printing—reproduction by direct contact rather than projection enlargement. Microfilm positives, reflex prints, diazo prints, and blueprints are made by contact printing.

Contax—35 mm. camera useful in low reduction microfilming where quantity is not a factor and speed of operation unimportant. Accessories made by manufacturer—Carl Zeiss.

Contrast—the degree of differentiation between the light and dark portions of a negative or print. A high contrast negative that yields

clear white and jet black reproductions has a high gamma (3.5 to 4.1), a density of about 1.6. This negative has a dense black background showing clear transparent lines and figures. Good contrasty positives result from high contrast negatives.

"Copy"—the records submitted for microfilming.

Copying—reproducing by one or more means.

Copying Regulations—The following may not be copied photographically. There are penalties of fine or imprisonment for those found guilty of making such copies. Ignorance of the law is not accepted as an excuse.

Obligations or Securities of the United States Government, including:

Bonds
Certificates of Indebtedness
National Bank Currency
Coupons
United States Notes
Treasury Notes
Gold Certificates
Silver Certificates
Fractional Notes
Certificates of Deposit
Bills, checks, or drafts for money, drawn

by or upon authorized officers of the United States.

*Stamps and other representatives of value, of whatever denomination, which have been or may be issued under any Act of Congress.

†Coins or money in any form.

Adjusted Compensation Certificates for Veterans of the World War.

Amateur Radio Operators' Licenses.

Automobile Licenses; Drivers' Licenses: Automobile Titles in Certain States.

Certificates of Citizenship or Naturalization.

Copyrighted Material (without permission of the owner of the Copyright)

Immigration Papers.

Passports.

Obligations of any Foreign Government, Bank or Corporation.

Draft Cards.

* Stamps may be copied at a linear reduction of less than ¾ times or more than 1½ times. If a stamp is reproduced same size, a line must be drawn across the surface of the picture. Foreign stamps must likewise be mutilated in all cases irrespective of reduction.

† Coins may be reproduced only if a line is drawn across the face of the picture or may appear without such mutilation if microfilmed for numismatic collections or dealer's catalogs.

Exception

When it is necessary to copy a legal document on which there is a cancelled revenue stamp, this may be done by authority of Sec. 402.2 of Internal Revenue Bulletin No. 7 entitled "Reproductions Authorized":

> "Authority is hereby given to make, hold and dispose of black and white reproductions of cancelled United States Internal Revenue Stamps provided that such reproductions are made, held and disposed of as part of and in connection with the making, holding and disposition for lawful purposes of the reproductions of the documents to which such stamps are attached."

In case of any uncertainty it is recommended that you ask the advice of your attorney.

Correct Exposure—the exposure which upon development yields the preferred density.

Counter, Frame—a continuous indicator showing the total exposures made.

Coverage—the area microfilmed at a particular height and focus.* E.g., Four standard coverages (A, B, C, D) are used on Microstat J-7 cameras fitted with a 60 mm lens. E cov-

erage, the largest, is a special setting calibrated for 50 mm lens cameras.

A *coverage* (9 x 12 inches)
B *coverage* (12 x 18 inches)
C *coverage* (18 x 24 inches)
D *coverage* (24 x 36 inches)
E *coverage* (28 x 42 inches)

Cover Plates—light-tight metal plates fitted to cover film magazines so as to prevent light fogging the film within.

Cycle—a period of electrical timing that repeats itself.

D

D-11—a high contrast developer.

Defender—manufacturer of papers used in projection printing, especially Photo Writ and Velour Black.

Dagor—a lens made by Goerz used on several of the best microfilming cameras.

Darkroom—literally a room that is light-tight and hence dark. Most reproductions must be made with red lamps only. No stray light from other sources can be permitted to enter the darkroom. Film darkrooms must be also perfectly light-tight and the only illumina-

tion permissible is that from a 10 watt green safelight facing the dials of the time clocks.

DC—abbreviation for Direct Current

Definition—the power of a lens to give a distinct image.

Densitometer—an apparatus for measuring density.

Density—the amount of silver remaining in the emulsion after processing. Microfilm should not exceed 2.5 or fall below 0.8. A good line copy negative is about 1.6.

Depth of Focus—the range of distances between which sharpness is maintained.

Depue—16 and 35 mm. microfilm printers manufactured by Oscar B. Depue.

Desk, Editing—microfilm inspection apparatus.

Developers—contain developing agents, preservatives, alkalies, restrainers, and water.

Developmcnt—the process of revealing the latent photographic image by the use of a developer.

Developing Agents—include amidol, elon, glycin, gradol, hydroquinone, kodelon, metol, paraphenylenediamine, pictol, pyrogallal, rhodol, rubinol, etc.; all are toxic if taken internally; many may produce a skin rash.

Dexigraph—a reproduction apparatus devised by

Remington Rand to make copies on paper negatives of small size.

Diaphragm—the iris aperture of a lens.

Diazo—an aniline dye series.

Diazo Print—a reproduction made by the diazo aniline dye process on one of several types of contact printing machines developed by Bruning (BW), Dietzgen (Directo), General Aniline (Ozalid).

Dichroic Fog—Chemical fogging of film resulting in opalescent or iridescent deposits of silver.

Dietzgen—manufacturer of diazo, blueprinting, and drafting equipment.

Directo—a diazo print made on the Dietzgen machine.

Documentary Reproduction—microfilming of records

Dryer—an electrically driven heater for drying reproductions.

Drying Drum—device for drying microfilm.

Duplicate Tracings—copies of original tracings that will serve to make diazo prints and blueprints. All translucent and transparent reproductions—paper, cloth, acetate—are duplicate tracings.

Du Pont—manufacturer of *Microcopy* microfilm, photochemicals, etc.

E

Easel—a paper frame sometimes used in holding sensitized materials to the camera table during projection enlargement.

Eastman—manufacturer and supplier of *Microfile* microfilm, photographic chemicals, papers, etc.

Edge-Notch—a semicircular punched hole made on the unperforated edge of microfilm to indicate a retake.

Editing Desk—an inspector's apparatus for examining microfilm.

Edwal—manufacturer of photographic chemicals and many prepared solutions.

Ektar—a lens made by Eastman used on several of the best microfilm cameras and enlargers.

Electro-Copyist—a contact reflex printing device manufactured by Hunter.

Electronics—the application of the electron theory.

Element, Lens—a component part of a lens. The Dagor lens contains six elements.

Emulsion—the photosensitive coating applied to

microfilm or reproduction substances such as paper, cloth, acetate.

Emulsion Number—the makers batch number. Useful in checking the constancy of relative exposure speed.

Enlarger Lamp—lamp made of opal glass.

Enlarger Timer—device for timing the exposure cycle of an enlarger and set by a switch.

Enlarging—projection printing.

Errors, Camera—fades, scratches, fogging, sprocket tears, etc.

Processing—finger-nail scratches, chemical stains, water spots, finger marks, etc.

Exposure—act of placing a latent image on a photosensitive substance or the amount of light allowed to pass through the lens onto the film or paper.

Exposure Meters, Incident—a meter measuring the incident light in foot candles. See *Meters*.

Reflectometer—a meter calibrated by means of the incident meter and test strips and used to determine the correct exposure of individual frames. See *Meters*.

F

F-1—fixer formula for photographic papers.

F-5—fixer formula for film.

Fahrenheit—a system of temperature measurement.

Fassel—high-speed, automatic-feed 16 and 35 mm. microfilming camera.

Feed Magazine—compartment used for holding unexposed film.

Ferricyanide, Potassium—compound used in bleaching.

Field—applying to operations outside the home plant.

Field Supervisor—supervisor of field camera crews and operations.

Film-a-record—16 mm microfilm camera made by Remington Rand.

Film Cans—containers for holding rolls of microfilm.

Film Cement—a specially prepared compound made for splicing acetate base film. Do not attempt to use nitrate film cement.

Film, Negative—the original photographic image from which positive prints are taken, or a duplicate negative made from a positive or by the Ozalid process.

Positive—a contact print made from the negative and showing light and shade as in nature, not reversed as in the negative.

Film Clerk—one assisting the inspectors in bill-

ing, labelling, wrapping, shipping, and ordering retakes of microfilm.

Five Foot Tank—a small light-tight processing tank used to develop and fix test strips.

Fixation—the removal of any sensitive substance not acted upon by light or the developer and thus rendering the microfilm or reproduction unalterable by further action of light. This is accomplished by the use of a fixing formula containing sodium thiosulfate or thiamate.

Fixer for Film—a special formula compounded for fixing and hardening microfilm negatives and positives.

Fixer for Reproductions—a special formula compounded for fixing reproductions and eliminating their red dye at the same time.

Fixer for Test Strips—a simple formula for fixing microfilm test strips in the field. This fixer is not suitable for other purposes as it contains no hardener.

Focus, Production—precision focus arrived at by calibration.

Visual—focus taken visually, a first step in arriving at a production focus.

Fog, Chemical—due to contamination with chemicals.

Light—due to exposure to light other than a

specified and tested safelight. Fog is a sign of carelessness, it occurs on both film and reproduction substances—paper, cloth, acetate.

Fonda—automatic film processing machine made by Fonda Machinery Company.

Foot Candles—measure of light intensity shown on the *Incident Light Meter.*

Foot Switch—button pedal used in making exposures.

Frame Counter—a number indicator showing the total exposures made.

Frames—individual exposures. Motion picture size single frames of 35 mm. film (1 x ¾), double frame microfilm usually 1 x 1½ inches.

Frilling—a condition of film improperly manufactured or carelessly processed. Frilling occurs along the edges and results from the separation of the emulsion from the film base.

f-Stop—the aperture number or f-number. By varying the f-stop the amount of light may be controlled.

G

Gamma—the relation of density to exposure determined by the use of H. & D. sensitometric

strips. One simple formula for determining gamma is:

Density 10th H. & D. square minus density 8th H. & D. square divided by 0.3 equals gamma. The gamma reading for high contrast negatives should range between 3.7 and 4.1.

G-E—General Electric Company, manufacturer of photoflood lamps and light meters used in microfilming.

Glacial Acetic Acid—a 99% concentrated acid used in compounding fixer for film.

Glazed Background Paper—waterproof white paper used to cover the camera table.

Goerz Dagor Microfilm Lens—a microfilming lens supplied by the C. P. Goerz American Optical Company.

Graflex Photorecord Camera—microfilm cameras made for professional use by the Folmer-Graflex Corporation.

Grain—a mottled structure in negatives improperly developed, a separation of the image upon magnification, results from lack of temperature control, excessive contrast.

Graphic—microfilm service using cameras and readers of their own manufacture and invention.

Gray Scale—a predetermined standard scale of values ranging from black to white. An evenly balanced gray scale is a sure indication of correct exposure.

Green Safelight Lamp—a Wratten series 3 safelight or equivalent used with a 10 watt incandescent lamp to illuminate the dials of the interval timers in the film processing darkroom. Never use a red or orange light in this room—it will fog the film.

Griswold—a film splicer.

H

Haloid—manufacturer of *Rectigraph* photocopying equipment, attachment for enlarging microfilm, also photographic papers.

Hardener—one of several compounds that harden the emulsion.

H. & D. Strips—sensitometric strips of film used by processors to check their processing and by inspectors to determine gamma. See *Sensitometric Strips.*

High Contrast Developer—one producing contrast rather than a long scale of gray tones.

Holbrook—manufacturer of microfilm cameras, printers, readers, and operating on a service basis to the general public.

Hypo—prismatic crystals of sodium thiosulfate or hyposulfite of soda.

Hypo Elimination Test—a National Bureau of Standards Test made to insure correct washing of microfilm.

I

Incident Light Meter—a photoelectric cell reading incident light in foot candles. See *Meters*.

Inconel—stainless metal recommended for manufacture of film reels, tanks, sinks, mixing vessels.

Inspection Desk—see *Editing Desk*.

Inspector—an individual charged with the inspection of microfilm and all duties related thereto.

Insurance Policy—a service first offered with Microfilm-by-Microstat. The Microstat Insurance Policy guarantees to the insured that in the event of catastrophe his records that have been microfilmed will be replaced by reproductions.

Interval Timer—an electric or spring operated darkroom clock used to announce the end of time periods in processing.

Iris—the diaphragm opening of a lens.

J

Job Identification Chart—a white lettered black chart giving the roll number, the date the roll was exposed, the coverage, etc.

Journal of Documentary Reproduction—issued by the Society of Documentary Reproduction, edited by Dr. Vernon D. Tate, published by the American Library Association, the "house organ" of the microphotographic technician.

K

Kelvin, Degrees—measure of light color temperature.

Kodachrome—Eastman color film useful in microfilming in full color rather than black-and-white.

Kodagraph—trade name of an Eastman acetate base film used in making acetate reproductions.

Kodak—trade mark of Eastman products, film, cameras, chemicals.

Kodalith—trade name of an Eastman sensitized waterproof cloth used in making cloth reproductions.

L

Lamp, Enlarger—a lamp made of opal glass.

Red—a ruby red lamp used in the reproduction darkroom. (Not for film.)

Reflectorflood—a 150 watt lamp used in drying microfilm.

Reflector Photoflood—a 500 watt lamp used in exposing microfilm.

Safelight—panchromatic green lamp housing (Wratten series 3 or equivalent) containing a 10 watt incandescent lamp.

Leader—a length of raw stock film used to lead a negative roll to be positive printed. The leader is attached to the roll by splicing.

Leica—35 mm. amateur camera useful for microfilming small quantity work. Excellent attachments supplied by the manufacturer, E. Leitz.

Leitz—manufacturer of Leica cameras, enlargers, projectors, accessories.

Lens—a specially ground process objective made for microfilming. The lens must be kept clean, free from dust, film particles, oil, fingermarks. Care must be taken not to scratch its surface while cleaning with lens tissue. To clean the lens one should blow

on it, carefully dust away any particles of foreign matter adhering to its outer surfaces, wipe these surfaces gently with clean lens tissue, repeat the brushing operation to remove any stray bits of tissue. Typical 40, 50, 60 mm. process lenses for microfilming are the Eastman Ektar, Goerz Dagor, Bausch & Lomb Micro-Tessar, Leitz Elmar, Zeiss Sonnar.

Lens Aperture—the f-stop opening of the iris diaphragm.

Lens Brush—tool for cleaning lenses.

Lens Tissue—a specially prepared soft tissue paper used in cleaning the lens. See *Lens.*

Lights Level—Operators must check the center and four corners of their camera table to see that the lights are level at all times. This is checked by using an incident light meter.

Linen Tester—synonym for pocket magnifying glass used by camera operators to examine test strips of film.

l/mm—abbreviation for lines per millimeter or the number of lines that the camera will resolve in a millimeter.

Loading Magazine—the *Feed Magazine* of a camera.

Loading Rack—apparatus for leading microfilm rolls on to the processing reels.

Logbook—a record kept of work performed.

Loupe, Magnifying—a magnifying glass used by inspectors, usually of 10 power.

M

Magnifying Glass—a linen tester type of magnifier used by camera operators, a 10 power magnifying loupe used by film inspectors.

Maintenance Supervisor—a supervisor, often the field supervisor, trained and instructed in maintaining and repairing cameras and microfilming equipment.

Mallinckrodt — manufacturer of photographic chemicals.

Mat—a dull surface paper designation, antonym of glossy.

Meters—Meters are extremely sensitive scientific instruments made with great accuracy and precision. Naturally they must be handled with the greatest of care as they are sensitive to even slight jarring. Their indicator needles are pinioned between jewel bearings. Any slight shock tends to dislocate their delicate adjustment. For this reason all technicians are cautioned to handle meters extremely

gently. Never set meter down with a jar. Never pack meters in such manner as to subject them to bruises or shocks from other tools or equipment. Meters found to be defective should be repaired by the manufacturer.

Microcopy—trade name of Du Pont microfilm.

Microfile—trade name of Eastman microfilm.

Microfilm Corp.—microfilm service organization operating in and around metropolitan New York.

Microfilm Engineers—a consultant service.

Microfilmer—"house organ" of The Microfilm Corporation, contains articles of technical as well as trade interest.

Microfilming—the compressed recording of vital records on high contrast, high resolution, safety film of miniature size.

Microphotography—that branch of photography dealing with the reduction of images to an extremely small scale and their reproduction back to original size.

Microprint—printing involving use of microfilm but reproduction of text on paper cards read by reflection in a Readex machine.

Microscope—an instrument used by inspectors to determine the resolution of microfilm.

Forty power microscopes are standard for this purpose.

Microstat—a trade mark registered in the United States Patent Office and designating the products of the Microstat Corporation and its licensees. The word is also used to identify their precision reproductions—*Microstats*. Positive printers and readers are manufactured as well as camera-projectors.

Microstat Company of California—service organization operating in the West.

Microstat Corporation of New England—services New England states.

Microstat Corporation of Pennsylvania—service in Pa., N. J., Md., Delaware.

Microstat Corporation of Pittsburgh—operates in western Pennsylvania, West Virginia and Maryland.

Micro-Tessar—a microfilming lens supplied by Bausch & Lomb.

Minipan—trade name of Ansco microfilm.

MM—abbreviation for millimeter.

Motor, Camera—used to operate the shutter and transport film.

MT4—Microstat's *Hypo Elimination Test Solution* compounded according to National Bureau of Standards specifications.

Multiple Exposures—a continuous series of frames of a single piece of copy exposed in overlapping sections. Often referred to as "bites." For example, a drawing taken in four sections is spoken of as "1/4 up."

N

Negative—the photographic image in reverse and as registered on the negative film from which positive prints are made.

Net Billing—same as net count or the total number of frames exposed minus all deductions for blanks, duplicates, camera and processing errors.

Neumade—manufacturer of film handling equipment, splicers, etc.

Newton's Rings—iridescent rings caused by close but not perfect contact between two surfaces. If, for example, the pressure plate of the J-7 is not perfectly seated on the film during projection printing, the characteristic Newton rings will appear on the finished print.

Novex—trade name of a reading machine that projects as well as reflects on a groundglass.

O

Opacity—the quality of opaqueness, not transmitting light. A word applied to double-weight photographic papers.

Operator—an individual specially trained in the operation of cameras.

Orthochromatic—emulsions sensitive to violet, blue, green, and yellow light but relatively blind to orange and red.

Overexposure—a negative lacking in contrast due to the flattening of the highlights. An over-exposed print is dark and heavy.

Ozalid—a diazo process reproduction on paper, cloth, or film developed by the action of aqua ammonia gas; thus a diazo process for making duplicate negatives and positives developed solely by the action of aqua ammonia gas. Film and apparatus made by Ozalid Division of General Aniline and Film Corporation (formerly called the product—Ozaphane).

P

Pako—manufacturer of print dryers.

Panchromatic Emulsion—type of film used to insure the fullest possible rendition of colors

and tones in the original copy as transferred to the microfilm. Film sensitive to all colors in terms of black, grey, and white tones.

Paper, Bromide—long scale photographic paper used in reproducing halftones.

Glazed Background—used to cover the camera table.

Silicon Carbide—used in scouring Stineman reels.

Silver Tissue—sulphur free paper used in wrapping film.

Photo Writ—document type paper used in making enlargements.

Paper Print—a black-and-white reproduction made by contact or projection on paper of single- and double-weight.

Pathe—microfilming service, cameras, processors supplied by Pathe Mfg. Co.

PD-5—an extremely high contrast developer.

pH—the degree of hydrogen ion concentration. A pH of O represents a strongly acid solution; pH7 is neutral solution or pure water; pH14 is a strongly alkaline solution.

Photo-Copying—copying by a photographic process.

Photoelectric—applied to selenium cells activized by light as in light meters.

Photoflood, Reflector—lamps used to illumine copy.

Photography—the science of forming and fixing an image of an object by the chemical action of light on a film, paper, or other photosensitive substance.

Photorecord—microfilm cameras made by Folmer-Graflex Corporation.

Photosensitive—sensitive to the chemical action of light, applied to film, photographic paper, etc.

Photostat—a copying process employing a paper negative; especially applied to apparatus and products of the Photostat Corporation.

Photo Writ A—document paper of single-weight, used in making Microstats.

B—document paper of double-weight.

PH/R-2 Reflector Photoflood Lamps—light source rated at 500 watts, 100-120 volts, used to illuminate copy.

Pictorial Events—microfilm specialists in educational slide film products and service.

Plant—applying to operations within the production laboratory.

Plant Supervisor—an individual charged with the supervision of all plant operations.

Portagraph—a contact or reflex copying device manufactured by Remington Rand.

Positive—film made from a negative in which the image appears in its natural relation as in a lantern slide.

Potassium Alum—a compound used in preparing fixer for film.

Potassium Bichromate—a compound used in developing blueprints.

Potassium Carbonate—alkali used in developer PD-5.

Potassium Ferricyanide—a compound used in bleaching paper prints.

Precision Microfilming Corporation—a service organization operating in Michigan.

Preservatives—include sodium sulfite, sodium bisulfite, potassium metabisulfite, and sugar.

Pressure Plate—optically plane glass plate in some camera heads used to hold the film flat during exposure.

Printer—contact printing apparatus for making positives from negatives and duplicate negatives from positives.

Processing Reels—reels constructed to hold microfilm to be processed.

Processing Steps—developing, fixing, washing, drying of film, paper, cloth, acetate, etc.

Processing Trays—trays holding developer or fixer and fitted with a central spindle permitting the processing reel to be agitated by rotation during processing.

Processor—an individual charged with the duties of processing microfilm.

Projection Printing—enlarging negatives onto photosensitive substances.

Punch, Inspector's—instrument for cutting circular holes in duplicate or spoiled microfilm frames or for edge-notching frames to be retaken.

Q

Quick-Fix—fixer produced by Edwal Laboratories:

Quota—the production requirement to be contributed by a camera crew, plant, sales force, etc.

R

R-2—Reflector photoflood lamps used to illuminate copy.

Rack, Loading—apparatus for loading microfilm on processing reels.

Reader—an optical device for viewing microfilm.

Readex—a microprint reader invented by Albert Boni and marketed by the Readex Microprint Corporation.

Record—a legal document, state paper, page of a book, map, photograph, drawing, contract, blueprint, deed, check, voucher, letter, will, statistic, etc.

Record Registry—a midwestern microfilming service.

Recordak—a subsidiary of Eastman Kodak engaged in microfilming since 1928; name of full line of professional cameras and readers manufactured by the Recordak Corporation and originally invented by George L. McCarthy. Service operation throughout the United States.

Rectigraph—photo-copying equipment made by the Haloid Co.

Red Lamp—see *Safelight*.

Reducer—a formula for the removal of excess silver deposits on film or paper. See *Bleaching*.

Reduction Ratio—obtained by dividing the length of a single film frame into the length of the copy.

Reel Loader—see *Loading Rack*.

Reels, Silver—processing reels made of silver and accommodating 118 feet of microfilm.

Stineman—processing reels made of Monel metal and holding 108 feet.

Watson—processing reels made of silver plated brass and holding 100 feet.

Reflectormeter—a photoelectric meter used to determine the correct exposure by measuring the light reflected from the copy on the camera table.

Reflectorflood Lamps—150 watt lamps used in drying microfilm.

Reflex Copying—a contact printing method employed in the Apeco, Electro-Copyist, Portograph and other commercial processes.

Remington Rand—microfilm service and equipment company.

Reproductions—photographic enlargements or contact prints.

Resolution—the resolving power of a microphotographic process (film emulsion, lens, etc.) expressed in lines resolved per millimeter (l/mm). Microfilm resolution should never drop below 65 l/mm.

Resolution Chart—a chart used to determine resolution consisting of horizontal and vertical lines and spaces arranged in a size graded series measured microscopically.

Restrainers—used to prevent developers from fogging by addition of potassium bromide,

sodium bromide, potassium thiocyanate, orthozite, sodium chloride, etc.

Retake Instructions—a form filled out by inspectors telling operators of retakes to be made.

Retakes—microfilm exposures that must be remade due to camera or processing errors.

Retouching—the art of removing or adding to an image in such manner that the artifice is not detectable.

Rewind, Pistol-Grip—apparatus supplied by Microstat for taking film off the drying drum.

Rinse Bath—see MR5.

Roll—a coiled length of microfilm (in 35 mm. film usually 100 feet long and containing about 750 exposures).

Ruby Red Safelight Lamps—lamps used for darkroom illumination. Do not use in film processing room.

S

Safelight—a light that is "safe" for a particular type of photographic film or other substance —paper, cloth, acetate, etc.

Safety Film—acetate base microfilm used because of its fire-resistant nature.

Sales Survey—an estimate made of the number of pieces of copy to be microfilmed and spec-

ifications containing the best method of servicing.

Scratches, Camera—caused by the camera.

Processing—caused by carelessness in loading or handling film.

Sectionalized Reproductions—reproductions made from multiple exposure negatives by butt- or lap-joining the sections enlarged.

See-Sharp—a focusing aid used in calibration.

Sensitometric Strips—H. & D. film strips used to determine gamma. H. & D. is the abbreviation for two investigators in sensitometry—Hurter and Driffield.

"Shoot"—slang for taking a picture.

Short-Stop Bath—a solution containing 28% acetic acid.

Shutter—a device in a camera head for momentarily exposing the film to light.

Shutter Motor—the shutter and film transport mechanism

Silicon Carbide Paper—abrasive scouring material used in cleaning Stineman reels.

Silver Reel—a processing reel made of silver and holding 118 feet of microfilm.

Silver Tissue Paper—a sulphur-free substance used in wrapping microfilm.

Sodium Carbonate—alkali used in making developers.

Sodium Bisulfite—compound used in preparing fixer for enlargements.

Sodium Sulfite—compound used in preparing fixer for film.

Sodium Thiosulfate—prismatic crystals of hypo. The active ingredient in most fixer formulas.

Solenoid—an electro-magnetic switch.

Solution—a liquid combination of a liquid and a non-liquid substance, e.g., hypo crystals and water make a solution useful in fixing test strips.

Southwestern Microfilming Corp.—supplies microfilm of books about the Southwest.

Spencer—a trade name applied to a projection type reader made by the Spencer Lens Company.

Splicer—a device for splicing film.

Sponge, Viscose—absorbent used in drying microfilm.

Spool—a flanged cylinder upon which microfilm is wound.

Sprocket Clutch—device within Microstat camera heads for engaging the sprocket wheel to the motor drive shaft.

Holes—perforations along the edge of film.

Teeth—projections on the periphery of the sprocket wheel spaced to engage the sprocket holes of the film.

Wheel—toothed cylinder used to engage the film and transport it from the feed magazine to the take-up magazine.

Squeegee—rubber edged blade used to remove excess water from the surface of reproductions as they are taken from their rinse preparatory to drying.

" 'Stat"—slang for reproduction, enlargement, as in *Photostat*, *Microstat*, etc.

Stineman Reel—a metal processing reel holding 108 feet made by R. P. Stineman, Inc.

Stop Down—to close the iris diaphragm of a lens so as to admit less light or sharpen the focus.

Stripping Flange—a type of disk fitted on microfilm printers and editing desks; made to facilitate the unloading of tightly spooled rolls of film.

Supervisor, Field—one in charge of field camera operations.

Maintenance—one in charge of maintaining and repairing cameras and microfilming equipment.

Plant—one in charge of all plant operations.

Survey Engineer—an individual making estimates of records to be microfilmed and specifying the most efficient methods.

SVE—trade name of a reader that reflects on a ground glass built and sold by the Society for Visual Education, Inc.; also a line of film projectors.

T

Table—a flat horizontal easel for copy.

Take-Up Magazine—film chamber for holding exposed film.

Tank, Five-Foot—a light-tight processing tank used to develop short strips of microfilm.

Technician—one versed in the methods of a science.

Test, Exposure—made by the use of test strips.

Hypo Elimination—made to determine the adequacy of washing.

Resolution—made to determine the resolving power of a lens at a particular height and focus.

Test Strip—a short strip of film made to determine density, resolution, lighting, etc.

The Microfilm Corporation—service organization operating in Ohio, Indiana, Kentucky, etc.

Thermometer—instrument for measuring temperature.

Thermosalt—an Edwal product useful in hot weather processing.

Thiamate—a long lasting three minute fixing agent made by the Edwal Laboratories. Does not contain hypo.

Time and Temperature—phrase indicating the correlation of two very important factors in the processing of film and in the making of reproductions.

Timer, Enlarger—electrical device controlling the shutter cycle during projection enlargement.

Interval—clock provided with settings to announce the end of a time sequence by sounding an alarm.

X-Ray—electrical interval timer.

Title Block—see *Job Identification Chart.*

Trailer—a length of raw stock film used to trail a roll to be positive printed. The trailer is attached to the roll by splicing.

Transformer—a rheostat controlling the intensity of lighting.

Transparencies—acetates, positive and negative film X-ray film, lantern slides.

Tray, Processing—pan used in developing and fixing film.

Washing—pan provided with a water jet connection.

U

Underexposure—a negative lacking in contrast in its darker parts. In prints the detail may be entirely lacking.

University Microfilms—company engaged in microfilming service for colleges and universities here and abroad.

"Up"—term used to describe the number of pieces of copy taken in a single exposure. "One up" means one piece to the exposure, "two up" two pieces, etc. "Half up" indicates that a drawing has been taken in two overlapping sections, each section on one frame.

V

Van Dyke—a reproduction showing white lines on a brown background; yields blueline prints.

Vault, Film—container for storing, safeguarding, or shipping rolls of microfilm.

Record Shipping—container for transporting vital records of a customer to the plant for house microfilming and return.

Vellum, Transparentized—a substance used in making reproductions.

Vibration—sometimes caused by careless operators who lean against the camera table, more often by sudden or continuous machine poundings within a factory. Vibration may be eliminated by the use of rubber pads placed beneath the camera.

V-Mail—Eastman microfilming process for handling overseas mail for armed forces. Full advantage is taken of space-saving character of microfilm by use of 16 mm negative and reduced area enlargements of letters.

Viscose Sponges—absorbents provided for drying microfilm. They should be washed after each time used and kept immersed in a solution of aerosol within a covered sponge dish.

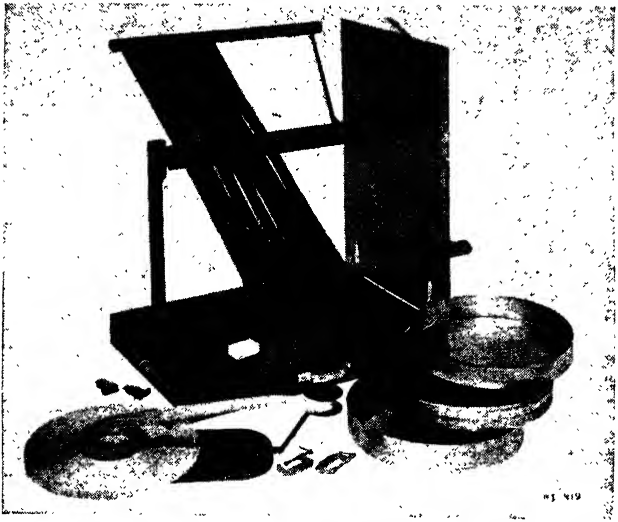
Volt—unit of electromotive force.

W

Washing—process of eliminating fixer from film and reproductions.

Washing Tray—an enamel pan fitted with a water inlet jet used in eliminating fixer from microfilm by the use of running water.

Water, Distilled—used in preparing special solutions requiring chemical purity.



Burke and James

Watson reel portable microfilm developing outfit permits field operations when laboratories are unavailable.

Tap—common water taken from spigot.

Temperature—for washing should not exceed 75 degrees Fahrenheit.

Warm—125 degrees Fahrenheit.

Washing—not in excess of 75 degrees Fahrenheit

Watson Reel—a silver plated processing reel constructed to hold 100 feet of microfilm by Burke and James.

Watt—unit of electrical power.

Westinghouse—manufacturer of photoflood lamps used in microfilming.

Weston—manufacturer of precision measuring instruments, thermometers, light meters; a system of emulsion speed ratings.

Wollensak—manufacturer of projection lenses.

X

X Coverage—designation of any extra or special coverage.

X-Rays—microfilmed by transillumination. Place X-ray negative on a flat lighted box, illuminate from beneath, make series of tests to determine correct exposure.

Y

Yellow Copy—a condition of old records resulting in negatives with a dense background but clear lines and figures. Inspectors approve such film if the lines are perfectly clear, unfrayed, ungrayed.

Z

Zeiss—manufacturer of the Contax camera and accessories, also lenses, Carl Zeiss, Inc.

"Zoot Gown"—colloquialism descriptive of white laboratory aprons and coats.

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—Ralph De Sola.

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(Definition and explanation of many technical and trade terms, only some of them appearing in this index, may be found in the preceding Glossary.)